REPORT ON THE
STATUS OF MALARIA AND
ANTI-MALARIA PROGRAMS:

Bangladesh
Burma
India
Indonesia
Nepal
Pakistan
Philippines
Sri Lanka
Thailand

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FOREWORD

This report has been prepared for USAID Asia Bureau/Technical Resources. The report reviews the status of malaria and the antimalaria programs in nine countries of Asia: Bangladesh, Burma, India, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka, and Thailand. The report will be used as background information for subsequent assessment of AID options in targeting health assistance. Consequently, only countries with an AID presence were reviewed.

This report was compiled from AID documents, WHO documents, national MCP reports, published journal articles, country-specific information cabled from the AID missions, written comments of reviewers, and personal interviews. The information was very uneven between and among the countries.

In a number of instances, a statistic or information was not available to the author working in Washington, D.C., though it may exist somewhere else. This is the meaning of the blank spaces in the statistics tables. The author regrets any errors, and would appreciate notice of corrections.

A sincere attempt has been made to be very honest with the available information. This is the reason for multiple entries in several of the data tables: for example, three sources may report three different numbers for the total number of cases in a year. Descriptions of activities in any country are reported as they were found in the available sources. Judgements reported are taken from the available sources.

The Introduction and Summary tries to briefly cover nine very different malaria situations, using tables and graphs.

The nine country chapters clinically describe each country's malaria program status.

Appendix B has comments on two general issues of assistance to these countries for antimalaria activities, followed by two recommendations.
SUMMARY

OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria in Asia is a major public health problem. The nine countries described in this report detected 2.5 million confirmed malaria cases (microscopically diagnosed) in 1982. Yet this number greatly underestimates the true prevalence of malaria. Some of these countries collect blood slides from only a minority of all suspected cases, choosing to treat on the basis of clinical diagnosis. E.g., Burma in 1983, reported 40,000 microscopically diagnosed cases, while also reporting 670,000 clinical diagnosed (and treated) cases; Indonesia in 1982, reported 105,000 microscopically diagnosed cases from the Outer Islands, and 1,215,000 clinically diagnosed cases. This alone would add over 1.7 million to the total number of cases.

Still this is an underestimate, since so many cases are never even seen by the national health services. Malaria is largely a rural disease (Pakistan and India have both urban and rural transmission), where the medical and health systems often have only partial and imperfect coverage.

Table 1-1. - Total Malaria Cases and Population Totals, 1982

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>38,204</td>
<td>91</td>
<td>.42</td>
<td>38,204</td>
<td>8.5</td>
<td>4.50</td>
</tr>
<tr>
<td>India</td>
<td>1,613,087</td>
<td>700</td>
<td>2.30</td>
<td>1,613,087</td>
<td>600</td>
<td>2.69</td>
</tr>
<tr>
<td>Indonesia</td>
<td>189,387</td>
<td>150</td>
<td>1.26</td>
<td>189,387</td>
<td>130</td>
<td>1.46</td>
</tr>
<tr>
<td>Nepal</td>
<td>16,907</td>
<td>15.1</td>
<td>1.12</td>
<td>16,907</td>
<td>9.5</td>
<td>1.78</td>
</tr>
<tr>
<td>Pakistan</td>
<td>55,497</td>
<td>71</td>
<td>.78</td>
<td>55,497</td>
<td>50</td>
<td>1.11</td>
</tr>
<tr>
<td>Philippines</td>
<td>96,776</td>
<td>50</td>
<td>1.94</td>
<td>96,776</td>
<td>40</td>
<td>2.42</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>38,566</td>
<td>15.1</td>
<td>2.55</td>
<td>38,566</td>
<td>8</td>
<td>4.82</td>
</tr>
<tr>
<td>Thailand</td>
<td>420,799</td>
<td>47</td>
<td>8.95</td>
<td>420,799</td>
<td>12</td>
<td>35.67</td>
</tr>
<tr>
<td>TOTALS</td>
<td>2,509,623</td>
<td>1,172</td>
<td>2.14</td>
<td>2,509,623</td>
<td>868</td>
<td>2.89</td>
</tr>
</tbody>
</table>
Figure 1-1. - Annual Total of Malaria-Positive Blood Slides
Figure 1-2. Annual Total of *Plasmodium falciparum*-diagnosed Blood Slides
TRENDS IN MALARIA BY COUNTRY

A severe caveat is necessary at the top. The huge size and population of the region, and the great variety of epidemiological situations even within individual countries, make it difficult to give a comprehensive summary [note Chapters 2-10]. Comparability of the malaria statistics across countries is not good, because the detection and reporting of malaria is so variable, depending on the efficiency of each country's system and the methods used to detect malaria (whether emphasis is on ACD, or PCD, or clinical diagnosis).

Another point, the transmission of malaria can fluctuate markedly over time, and this variation can be due to change in climate, politics, sociology, or vector bionomics, among other factors, all of which have been experienced in one or more of these countries.

Table 1-1. represents a snapshot of malaria status across the nine countries, from 1982, the most recent year with the most complete statistics (8 of 9 countries, Burma is the exception). This table could change dramatically from year to year, and Figure 1-1. helps to put the annual variation into perspective.

1. Thailand: Detects more malaria per capita than any other country. This probably reflects the severe status of malaria transmission in Thailand, and the relatively high efficiency of Thailand's detection system. Other neighbors could probably find as much malaria, if they had the developed infrastructure. Also, malaria incidence in Thailand dropped sharply in 1983. Within the Thai health system, malaria ranks as the highest cause of morbidity, and in the top ten causes of mortality.

2. Pakistan: Malaria is severely underestimated. The available statistics are for microscopically detected malaria, however, the PCD system in Pakistan has been admonished for many years for low blood slide collection. Malaria detection through PCD is virtually nil. Health centers, hospitals, etc. do not take blood slides from suspected patients. Treatment is made on clinical diagnosis. Available statistics come from ACD by malaria surveillance agents.

3. Burma: Malaria is severely underestimated, due to very limited scope of health and medical budget. Large majority of suspected cases are treated clinically. 25% of the population lives in remote rural areas without any active or passive detection mechanisms (but with high transmission).

4. Indonesia: Malaria detection underestimates actual incidence. The extension of health facilities into the Outer Islands is not yet comprehensive.

5. India: Malaria is underestimated. Current reports indicate that multipurpose health workers with responsibility for collecting blood slides have other health emphases. Also, India has set up Fever Treatment Depots and Drug Distribution Centers where the emphasis is on symptomatic treatment rather than blood slide collection.
6. Sri Lanka: Malaria is subject to severe seasonal fluctuation. 1982 was a low point. 1983 had tripped incidence.

7. Philippines: Malaria is common in the remote rural areas where the health system has imperfect coverage. In addition, the security situation severely hampers activity in rural areas.

8. Nepal: There are remote areas without coverage, but Nepal also carries out ACD and PCD.

9. Bangladesh: Efficiency of the detection system is not good.

(See Figure 1.)

1. Trend is downward in India, Thailand. This is believed to be accurate.

2. Trend is upward in Nepal, Pakistan, and Sri Lanka. All three countries have insecticide resistance problems, poor performance in spray operations, and spray refusal problems. Nepal is simultaneously experiencing more cases imported from India and rising incidence in An. annularis transmission areas. Pakistan and Sri Lanka are subject to periodic epidemic outbreaks. Pakistan shows rising incidence since 1979, but had large administrative changes in late 1970s that disrupted the program, thus it is not clear if increase is due to improved surveillance, operational problems, or a periodic increase in transmission.

3. There is no clear trend in Bangladesh, Burma, Indonesia, and Philippines. Transmission in Bangladesh is a focal problem in the hilly forested border areas. Large areas of Burma are omitted from any active coverage by antimalaria program. Transmission in Indonesia is a severe but largely undetected problem in the Outer Islands, as well as Java. Detected malaria has dropped in the Philippines, but reports indicate that the surveillance system is not functioning properly due to administrative changes.

(See Figure 2.)

4. Nepal: Falciparum malaria (P.f.) is <10% of total -- vivax malaria is predominant. Falciparum malaria is largely detected in cases entering from India.

5. Sri Lanka: Falciparum malaria is <5% of all cases -- vivax malaria is greatly predominant. Falciparum malaria shows trends similar to vivax.

6. Otherwise, falciparum malaria is an important component of malaria transmission in the other countries.

Notes on Figures 1 and 2.

1. Figure 1.: microscopically diagnosed malaria was graphed, because it was the only statistic available across most of the countries. (In Burma, SPR and total slides examined were available, however, not actual total of positive blood slides. Blood slide collection of suspected cases is not routine in Burma).

2. Figure 2.: Data was incomplete for many countries.
<table>
<thead>
<tr>
<th>Countries</th>
<th>Total Pop</th>
<th>Pop at Risk</th>
<th>Geographic</th>
<th>Season/Endemic</th>
<th>Parasite Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>91 million</td>
<td>8.5 million</td>
<td>Forested hills (border areas); Coastal areas; some irrigated plains</td>
<td>endemic (higher in rainy season)</td>
<td>P.f. (40% total): forested hills; P.v. (60% total): plains and coast</td>
</tr>
<tr>
<td>Burma</td>
<td>33 million</td>
<td>25 million</td>
<td>Forested hills; coastal areas; coastal plains; irrigated areas</td>
<td>endemic (higher in rainy season)</td>
<td>P.f. predominant species (&gt;80%)</td>
</tr>
<tr>
<td>India</td>
<td>700 million</td>
<td>500 million?</td>
<td>Virtually all rural areas with variety of pooled waters; some urban areas; coastal areas</td>
<td>seasonal; epidemic potential</td>
<td>P.v. predominant species (80%); P.f. important in NE</td>
</tr>
<tr>
<td>Indonesia</td>
<td>150 million</td>
<td>130 million?</td>
<td>Irrigated areas; coastal areas; forested hills (Outer Islands)</td>
<td>endemic (higher in rainy seasons, or according to rice season)</td>
<td>P.f. and P.v. about equal</td>
</tr>
<tr>
<td>Nepal</td>
<td>15.1 million</td>
<td>9.5 million</td>
<td>Terai (&lt;4000); tropical forests</td>
<td>seasonal</td>
<td>P.v. predominant species (&lt;90%); P.f. mostly imported</td>
</tr>
<tr>
<td>Pakistan</td>
<td>71 million?</td>
<td>50 million?</td>
<td>Urban (Karachi); rural areas (irrigated or monsoons)</td>
<td>seasonal</td>
<td>P.v. predominant species (70-80%)</td>
</tr>
<tr>
<td>Philippines</td>
<td>50 million?</td>
<td>40 million?</td>
<td>Rural foothills and mountains; coastal areas; irrigated areas</td>
<td>endemic</td>
<td>P.f. (60-70%); P.v. (30-40%)</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>15.1 million</td>
<td>8 million?</td>
<td>Pooled fresh water; river beds/banks</td>
<td>endemic in North &amp; East virtually all P.v. (&gt;95%) post monsoon epidemics</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>47 million</td>
<td>12 million?</td>
<td>Forested hills; slow moving streams; coastal areas</td>
<td>endemic (higher rainy season)</td>
<td>P.f. predominant species (65%)</td>
</tr>
</tbody>
</table>
**TOTAL POPULATION AT RISK**

The total population of these nine countries is estimated at 1.2 billion. Total population at risk of malaria transmission is estimated at 868 million (see Table 1-2.). Malaria is largely a rural disease, thus the huge numbers of people in these countries at risk. In addition, urban sectors in India and Pakistan are at risk (due to the vector *An. stephensi*).

Transmission being dependent on the presence of vector mosquitoes, the areas of risk depend on the environmental parameters of each vector. Over 20 various mosquito species transmit malaria in Asia in a variety of ecological settings. Briefly, *An. culicifacies* is associated with rural areas with a variety of fresh water pools (sometimes due to rainfall, other times due to failure of rainfall leading to pools in dry river beds); *An. stephensi* is associated with contained water in urban settings; *An. minimus* is associated with slow moving streams in forested areas; *An. sundaicus* is found breeding in brackish water at the sea coast; several other secondary vectors are also associated with coastal areas; in some cases, irrigated areas have transmission due to *An. aconitus* or several other vectors; *An. balabacensis* and *An. dirus* are notorious vectors in forested hills, exploiting very small pools of fresh rainwater; several other species are also associated with forested areas.

**PAST ANTIMALARIA ACTIVITY**

In all of the countries reviewed, antimalaria interventions were begun in the early 1900s. Then in the 1950s, malaria eradication campaigns were initiated in all of these countries. In most cases, very promising results were obtained at first. That is, as a result of intensive efforts, with external aid, malaria prevalence decreased during the first years of each eradication campaign. In a few cases, optimism rose that the final objective would be achieved. Bangladesh and Thailand eradicated malaria from their central plains. But in most cases, although significant decreases occurred, there was a leveling off that foreshadowed future problems.

Violent political developments interrupted two campaigns: for several years after the attempted coup in Indonesia, the malaria program was inactive; the independence war in Bangladesh disrupted that malaria program.

As the eradication campaigns began to stretch beyond their targeted endpoints, several countries took advantage of greatly reduced transmission to curtail the intensive efforts. This proved to be premature (the possibility of total eradication is moot). Disastrous epidemics occurred in Pakistan, India, and Sri Lanka, and also in Nepal and Thailand.

**CURRENT ANTI-MALARIA PROGRAMS**

**ERADICATION/CONTROL**

When time-limited eradication was abandoned by all these countries, the programs were reoriented under some form of malaria control strategy. Although malaria control strategy replaced the intensive eradication programs, it requires nevertheless a different type of intensity to implement a tailored program of tactics based on continuous, timely evaluation of the epidemiological situation within the various ecological settings of each country. This has not always been appreciated.
### Table 1.3 - General Program Description and Comments

<table>
<thead>
<tr>
<th>Countries</th>
<th>Recent Program History</th>
<th>Integration Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>time-limited eradication campaign during 1960s;</td>
<td>hybrid arrangement of HUWs for PHC (including malaria detection and treatment), UMJs for spray operations operations in high risk areas, supervision and surveillance</td>
</tr>
<tr>
<td></td>
<td>disrupted during civil war 1971/2;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vertical MEP merged into Integrated Thana Health Complex Scheme, 1977</td>
<td></td>
</tr>
<tr>
<td>Burma</td>
<td>time-limited eradication campaign during 1960s</td>
<td>hybrid arrangement of HUWs for PHC (including malaria detection and treatment), UMJs for spray operations, supervision and surveillance in high transmission areas</td>
</tr>
<tr>
<td></td>
<td>not feasible due to limited budget;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vector-Borne Disease Control unit formed in PHC-oriented health system</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>world's largest eradication campaign greatly reduced transmission in 1960s; hasty reduction of effort rapidly led to massive epidemic outbreak; intensified measures reintroduced</td>
<td>integration of vertical programs into general health services implemented 1978-82; malaria staff supervise, but multipurpose health workers implement anti-malaria functions-trouble in emphasis, esp. spraying</td>
</tr>
<tr>
<td>Indonesia</td>
<td>eradication campaign disrupted by political turmoil in mid-1960s;</td>
<td>integration of vertical malaria program into general health service now implemented; malaria staff supervise &amp; advise HUWs but no direct operational function</td>
</tr>
<tr>
<td></td>
<td>anti-malaria measures eventually reinstated, but not same intensity</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>eradication campaign entered consolidation 1960s;</td>
<td>vertical semi-autonomous malaria control program long-term plan to integrate malaria surveillance in phased manner as feasible</td>
</tr>
<tr>
<td></td>
<td>set-backs during early 1970s; program renamed long-term control program</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>eradication program gradually extended over entire country in 1960s; surveillance relaxed and insecticide resistance emerged leading to resurgence to epidemic levels</td>
<td>administrative integration, but functionally vertical</td>
</tr>
<tr>
<td>Philippines</td>
<td>numerous reorganizations since 1950s</td>
<td>integration of malaria program recently implemented; HUWs do surveillance, supervise local-hire spraymen</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>eradication campaign during 1960s greatly reduced transmission; intensive effort relaxed, plus adverse environ. conditions, led to malaria resurgence in massive epidemic; reintensified measures have reduced prevalence</td>
<td>vertical semi-autonomous program Sri Lanka Anti-Malaria Campaign</td>
</tr>
<tr>
<td>Thailand</td>
<td>eradication campaign steadily reduced transmission but budget cut plus operational problems during 1970s led to malaria resurgence; reintensified program has reduced malaria</td>
<td>vertical semi-autonomous program National Malaria Control Program long-term plan to turn over surveillance and treatment to general health services as feasible</td>
</tr>
</tbody>
</table>
Malaria control was defined in the 17th Report of the WHO Expert Committee on Malaria. This included a sequence of goals and associated antimalaria methods referred to as Tactical Variants. These four Tactical Variants represent the major possibilities for antimalaria activities, starting with provision of life-saving chemotherapy to prevent mortality and then progressing to reduction of morbidity, reduction of prevalence and endemicity, and finally intensive effort towards eradication. The strategy and tactics to be employed by any country, and within the various localities of any country, will vary according to the scope of the problem, and economic and political realities. To be most effective, the application of the Tactical Variants (esp. 2, 3, and 4) needs very good epidemiological analysis.

INTEGRATION

During the 1970s, integration of the vertical health programs (e.g., malaria and tuberculosis) into the general health service was endorsed as an objective. This gained impetus when the Primary Health Care (PHC) concept became accepted (emphasizing community-based multipurpose health workers, rather than unipurpose workers), but integration was also seen as a rational response to controlling the heavy expenditures associated with the intensive vertical antimalaria programs.

The term "integration" has some ambiguity. In some cases, it has meant normalizing the employment status of malaria staff, by integrating them into the administrative and salary system of the general health services. In other cases, it has meant redefining the job description of all unipurpose workers in vertical programs to become PHC multipurpose health workers (MHWs), and adding malaria surveillance and treatment to the duties of existing MHWs.

Three programs have implemented a complete integration of former unipurpose health workers into a PHC system (India, Indonesia, Philippines), eliminating the vertical program in name as well as function. All surveillance, detection, treatment, and spray operations are carried out or supervised directly by MHWs. The remaining unipurpose malaria staff have supervision and liaison duties, but no direct operational functions. Under such a system, these countries have experienced difficulty effectively implementing antimalaria measures. Full integration is a policy decision that seems to have resulted in poorer performance of antimalaria activities in India, the Philippines, and Pakistan. Indonesia reported performance difficulties earlier, but a modus vivendi seems to have emerged. It seems that the main force behind each of these reorganizations was economics.

Three other countries (Burma, Bangladesh, Pakistan) have adopted administrative structures that appear to have completely integrated their vertical malaria programs, but reports state that functionally they are hybrids with the antimalaria activities still performed by unipurpose malaria workers.

Finally, three programs remain, both in name and in fact, vertical, semi-autonomous malaria control programs (Nepal, Sri Lanka, Thailand). Each of these programs is making large annual expenditure for intensive spray coverage and surveillance throughout most of the country. The vertical program, with unipurpose malaria spray teams, surveillance, diagnosis, administrative and evaluation staff, is responsible for operational activities in those districts with high or moderate on-going transmission. In each program there is a long-term plan to turn over, to the general health service, those areas where ma-
Malaria transmission is sufficiently diminished such that malaria detection and treatment can be handled by multipurpose health workers, and where anti-vector activities are focal and intermittent.

CURRENT ANTIMALARIA TACTICS

Table 1-4 summarizes the current antimalaria activities of the nine countries.

Insecticide and entomology
1. All countries carry out intradomiciliary residual spraying (see also, section below on insecticide resistance).
   - Burma: spraying is very limited.
   - Indonesia: spraying is very limited in Outer Islands.
   - Philippines: spraying is carried out by local-hire spraymen, supervised by Barangay Health Worker.
2. Larviciding is not practical against many of the vector breeding sites in Asia (e.g., small puddles of rain water in the forest, or moving streams). India and Pakistan use larvicides against An. stephensi.
3. Most countries carry out some sort of routine entomological monitoring, such as vector density sampling and insecticide susceptibility tests.

ACD:
4. India: multipurpose health workers collect blood slides as part of duties.
5. Indonesia: ACD in Java-Bali only, none in Outer Islands
6. Pakistan: virtually all slide collection from ACD by malaria surveillance agents.
7. Philippines: multipurpose health workers collect blood slides as part of duties.
8. Sri Lanka: Activated PCD is carried out by malaria staff working at health centers. Most slides collected in this way.
9. Thailand and Nepal carry out ACD by malaria surveillance workers with case investigation as per the eradication model.

PCD:
10. Burma: PCD from only a fraction of all suspected patients -- most diagnosis by clinical symptoms.
11. Indonesia: PCD in Java-Bali by extensive health infrastructure; in the Outer Islands, only PCD (no ACD), and blood slides collected only from suspected cases as availability of limited microscopists permits.
12. India: Fever Treatment Depots and Drug Distribution Centers at village-level
13. Pakistan: although PCD supposed to be done in all hospitals, clinics, etc., in fact very little in spite of many admonitions over the years.
14. Sri Lanka: very few PCD slides collected at hospitals, clinics, etc.
15. Thailand: 450 village-level malaria clinics and 30,000 voluntary collaborators collecting blood slides, reducing time-lag from symptoms to diagnosis and treatment.
Drug Protocols
16. Suppressive treatment given at blood slide collection in all countries.
17. Due to extreme backlog for slide examination in India, suppressive treatment often constitutes the only treatment.
17. India and Indonesia: standard radical treatment for P.f. is single dose chloroquine.
18. Burma: suppressive treatment (single dose) is given to clinically diagnosed patients (i.e., most patients).

Voluntary Collaborators
20. In place in Bangladesh, India, Nepal, and Thailand. Thailand has recently expanded number of such workers, apparently with good results. India has Fever Treatment Depots and Drug Distribution Centers.

Other:
21. India and Indonesia have formal P. falciparum-containment programs in place in an effort to intensify efforts at controlling the drug-resistant malaria strains.
22. Some community-based or village-based projects are under way in India, Thailand, Indonesia, and the Philippines.
<table>
<thead>
<tr>
<th>Countries</th>
<th>Spraying</th>
<th>Larviciding</th>
<th>Entomology</th>
<th>ACD</th>
<th>PCD</th>
<th>Treatment</th>
<th>Vol. collabs</th>
<th>other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>DDT 2/yr; also 1/yr; focal</td>
<td>no</td>
<td>suscept. tests; density samp.</td>
<td>MHWs &amp; UMs</td>
<td>health estabs at all levels</td>
<td>radical Rx; presumptive Rx at B/S; M&amp;A; prophylaxis</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Burma</td>
<td>DDT 1/yr in limited areas; some focal</td>
<td>some</td>
<td>suscept. tests; density samp.; exp. field trials</td>
<td>MHWs &amp; UMs; health centers at all levels</td>
<td>radical Rx to confirmed case; suppressive Rx to clinical Dx; some prophylaxis</td>
<td>no</td>
<td>bioenvironment measures</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>DDT 2/yr, or malathion 3/yr also some HCH *350 million covered</td>
<td>yes (urban areas)</td>
<td>suscept. tests by MHWs; exp. field trials</td>
<td>Vector Control Research Center</td>
<td>health centers at all levels, also, volunteers</td>
<td>single dose radical Rx; presumpt. at B/S</td>
<td>yes</td>
<td>a) Pf containment Program b) ULV fogging in urban areas c) some community spraying</td>
</tr>
<tr>
<td>Indonesia</td>
<td>DDT 2/yr; complete cover in Java-Bali; limited in Outer Islands</td>
<td>no</td>
<td>suscept. tests; density samp. only</td>
<td>Java-Bali species incrim.; vector bionomics Insecticide trials</td>
<td>health estabs at all levels</td>
<td>single dose chloro, or S-P; or 9 (x7d.) radical Rx in non-transmission areas</td>
<td>no</td>
<td>a) chloro-resist Pf containment Program b) village-based malaria control</td>
</tr>
<tr>
<td>Nepal</td>
<td>malathion 2/yr; (A. annularis); DDT 2/yr</td>
<td>no</td>
<td>suscept. tests vector bionomics UMs densities, etc.; very active</td>
<td>MHWs</td>
<td>all health estabs</td>
<td>radical Rx 5-day chloro; S-P all import P.f.; presumpt. Rx at B/S</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>malathion 2/yr; DDT, BHC; fenitrothion</td>
<td>yes, by municipal govt.</td>
<td>vector density monitoring; suscept. tests mostly malaria agents</td>
<td>very few slides collected</td>
<td>radical Pf Rx 3-day chloro; radical P.f. Rx 5-day chloro; presumpt. at B/S</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Countries</td>
<td>Spraying</td>
<td>Larviciding</td>
<td>Entomology</td>
<td>ACD</td>
<td>PCD</td>
<td>Treatment</td>
<td>Vol. collab</td>
<td>other</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
<td>-------------</td>
<td>---------------------------------</td>
<td>--------------</td>
<td>---------------</td>
<td>-------------</td>
<td>-------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Philippines 1</td>
<td>DDT 2/yr</td>
<td>no?</td>
<td>?</td>
<td>HHWs collect B/S</td>
<td>health estabs</td>
<td>chloro?</td>
<td>?</td>
<td>a)community participation in antimalaria activities</td>
</tr>
<tr>
<td></td>
<td>local-hire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>spraymen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>malathion</td>
<td>some</td>
<td>full variety of standard entomological activities</td>
<td>UMW surveillance agents</td>
<td>very few PCD slides collected; but, Activated PCD by malaria staff suspected at health estabs cases</td>
<td>radical Rx w/chloro to microRx clinical &amp; protected; yes, many extreme radical Rx; most antimalarials ineffective</td>
<td>no</td>
<td>some limited ULV</td>
</tr>
<tr>
<td></td>
<td>4/yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2/yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>DDT 2/yr;</td>
<td>no</td>
<td>full variety of standard entomological observations</td>
<td>UMW surveillance all health</td>
<td>estabs</td>
<td>Fansimef Case Detect</td>
<td>yes,</td>
<td>a)program to increase village based clinics and vol. collab</td>
</tr>
<tr>
<td></td>
<td>some fenitrothion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 The Philippines completed in 1984 a total integration of antimalaria measures into the general health services, using multipurpose health workers. Recent information of current activities was not available.
Table 1-5. - Insecticide Resistance and Drug Resistance

<table>
<thead>
<tr>
<th>Country</th>
<th>DDT</th>
<th>dieldrin-BHC</th>
<th>malathion</th>
<th>other</th>
<th>chloroquine</th>
<th>sulfad-pyrim</th>
<th>quinine</th>
<th>other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>$\gamma^{1,2}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+++</td>
<td>$\gamma^3$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Burma</td>
<td>+++$^4;2$</td>
<td>-</td>
<td>-</td>
<td>$\gamma^5$</td>
<td>+++</td>
<td>+++$^6$</td>
<td>-</td>
<td>amodiaquine pyrimethamine proguanil</td>
</tr>
<tr>
<td>India</td>
<td>$\gamma^1,7$</td>
<td>$\gamma^7$</td>
<td>$\gamma^8$</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>- pyrimethamine</td>
</tr>
<tr>
<td>Indonesia</td>
<td>+9</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>proguanil</td>
</tr>
<tr>
<td>Nepal</td>
<td>++$^4$</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pakistan</td>
<td>+7$^2$</td>
<td>+7$^7$</td>
<td>+7$^{10}$</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Philippines</td>
<td>-</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>+ amodiaquine</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>+++</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thailand</td>
<td>$\gamma^2$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+++</td>
<td>+++$^+$</td>
<td>+ amodiaquine pyrimethamine</td>
<td></td>
</tr>
</tbody>
</table>

1. Exophily of *A. philippinensis* reported.
2. Excitrepellent behavior of *A. dirus*.
3. Sulfadoxine-pyrimethamine is reported as second line treatment. Quinine (x3 day) cum tetracycline (x7 day) is reported as third line treatment. Thus, S-P treatment-failure seems to be indicated.
4. DDT resistance in *A. annularis* and *A. cuticifacies*.
5. Fenitrothion resistance in *A. culicifacies* in some tests.
7. DDT and HCH/dieldrin resistance (high) in *A. culicifacies* and *A. stepheni*.
8. Malathion resistance in *A. culicifacies* and *A. stepheni*.
9. *A. aconitus* and *A. sundacius*.
10. Malathion resistance in *A. culicifacies* and *A. stepheni*. 
OPERATIONAL PROBLEMS
INSECTICIDE RESISTANCE and VECTOR BEHAVIOR

Table 1-5. summarizes the status of insecticide resistance in the region.

1. Selection for DDT resistance has occurred in all countries except Thailand, Bangladesh, and the Philippines.
2. Exophily, and/or excitorepellant behavior of vector species towards DDT, are important factors in Bangladesh, Burma, Indonesia, and Thailand (An. dirus, An. balabacensis, An. minimus, An. punctulatus).
3. In Burma, Nepal, Indonesia, some important vectors are resistant, but other vector species in those countries remain susceptible.
4. In Pakistan, India, and Sri Lanka, DDT resistance had serious consequences by occurring in principal vectors -- more expensive malathion was substituted.
5. Malathion resistance is now appearing in Pakistan, India, and Sri Lanka.

DRUG RESISTANCE
Table 1-5. summarizes the status of drug resistance in the region.

1. Drug resistance is a major problem. Thailand was one of the first countries in which chloroquine resistance was detected in the early 1960s. P. falciparum resistance to chloroquine is virtually 100% in Thailand. Since the 1960s, chloroquine resistant strains have emerged in all of the other countries, except Nepal and Sri Lanka (the isolation of each is probably one factor, but more importantly, in both countries prevalence of P. falciparum is rare).
2. Resistance to sulfadoxine-pyrimethamine (Fansidar) is widespread in Thailand, and has been confirmed in Burma and Indonesia.
3. Quinine resistance is prevalent in Thailand. Also old reports exist from Philippines and Indonesia.
5. Although chloroquine is not useful against P. falciparum, it is still effective against P. vivax and P. malariae.
<table>
<thead>
<tr>
<th>Countries</th>
<th>organization and management</th>
<th>logistics and transport</th>
<th>spraying</th>
<th>migration</th>
<th>drug resistance</th>
<th>insecticide resistance</th>
<th>others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>yes</td>
<td>yes</td>
<td>refusals</td>
<td>yes²</td>
<td>yes</td>
<td>no</td>
<td>a) shortage good quality DDT b) delay in filling vacancies c) no training budget</td>
</tr>
<tr>
<td>Burma</td>
<td>no</td>
<td>yes</td>
<td>very limited spray operations</td>
<td>some</td>
<td>yes</td>
<td>yes</td>
<td>very limited budget</td>
</tr>
<tr>
<td>India</td>
<td>yes</td>
<td>yes</td>
<td>other activities of MHWs detract from performance</td>
<td>some</td>
<td>yes</td>
<td>yes</td>
<td>a) family planning and other duties of MHWs reduce surveillance and spraying</td>
</tr>
<tr>
<td>Indonesia</td>
<td>yes</td>
<td>yes</td>
<td>refusals</td>
<td>yes¹</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>some</td>
<td>some</td>
<td>some coverage not TOCOSURE</td>
<td>Imported Pf cases from India; work in forest</td>
<td>no</td>
<td>yes</td>
<td>a) manpower shortage</td>
</tr>
<tr>
<td>Pakistan</td>
<td>yes¹</td>
<td>yes</td>
<td>refusals; poor supervision/ poor performance</td>
<td>Afghan refugees</td>
<td>yes</td>
<td>yes</td>
<td>integration not successful; DRT and EPI higher priorities</td>
</tr>
<tr>
<td>Philippines</td>
<td>yes¹</td>
<td>yes</td>
<td>refusals; local hire spraymen</td>
<td>yes</td>
<td>yes</td>
<td>limited</td>
<td>a) lack of security</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>some</td>
<td>some</td>
<td>refusals; poor supervision</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>a) lack of security</td>
</tr>
<tr>
<td>Thailand</td>
<td>some</td>
<td>some</td>
<td>refusals</td>
<td>yes¹</td>
<td>yes</td>
<td>yes</td>
<td>limited; epidemiological analysis</td>
</tr>
</tbody>
</table>

1. Lack of clear and distinct line of command under "integrated" scheme; confused and inadequate supervision.
2. Population pressure pushes people to transmission areas in forested hills (border areas); refugee camps in high risk areas.
3. Limited budget leads to modest program goals to implement.
4. Newly implemented integration scheme cannot be evaluated yet.
OTHER PROBLEMS OF PROGRAM IMPLEMENTATION

Table 1-6 summarizes various program problems in the region.

1. Refusal of spraying is a major problem in all countries resulting in suboptimal spray coverage. Two or three decades of indoor residual spraying has depleted the cooperative spirit. There are also chronic complications caused by local custom or habit, such as refusal of spray in the kitchen or bedroom, rub off by leaning against walls, replastering, and overcoating of spray by cooking fire smoke.

2. Internal migration of human populations, especially related to economic activities, is a major problem in Thailand, Indonesia, the Philippines, and Bangladesh, leading to reintroduction and spread of malaria throughout a country from malarious to non-malarious areas. A related problem is large populations of non-immunes exposing themselves to malaria while engaged in economic pursuits in forest transmission sites.

3. Related to this is the development of irrigation schemes, transmigration schemes, plantations, and other human settlements in malarious areas. Often such human activity leads to increased vector breeding. Forest resettlement: Indonesia, Philippines, Thailand, Bangladesh. Irrigation: Pakistan, Nepal, Philippines, and Indonesia.

4. Emphasis on other health activities detracts from some antimalaria efforts of health workers: e.g., in India, family planning is emphasized currently; in Pakistan, ORT and EPI are emphasized currently.

5. Lack of security and lawlessness is a serious problem in rural areas of the Philippines, Burma, and currently Sri Lanka, hindering access to highly malarious regions.

6. Shortage of equipment, material, transport, and personnel are chronic problems of all malaria programs. Increased costs are the main factor.

7. Coupled to the shortage of transport and personnel is the difficult access to many of the most malarious areas of most countries.

8. Shortage of personnel both at intermediate and professional levels is made more acute by unattractive salaries and career prospects. It is difficult to attract and keep experienced personnel.

9. Lack of administrative skills - management, supply, logistics - hinders many programs.

10. Mentioned above, is inadequately defined and poorly planned integration of malaria services into general health services. This seems to have occurred in Pakistan, Philippines, and Indonesia. A flexible approach is necessary to ensure that essential duties are given adequate manpower and other emphasis, if antimalarial measures are to have any effect.
Figure 1-3. Annual Budget Expenditure for Malaria

SUMMARY - 1-18
PROGRAM FINANCING

Table 1-7. and Figure 1-3. summarize funding of the national malaria programs in the region. As before, Table 1-7. represents a comparative snapshot, while Figure 1-3. can be used for time perspective.

Table 1-7. - National Malaria Budget Expenditures, 1982

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>2.448</td>
<td>91</td>
<td>.026</td>
<td>2.448</td>
<td>8.5</td>
<td>.288</td>
</tr>
<tr>
<td>Burma(1983)</td>
<td>1.641</td>
<td>33</td>
<td>.049</td>
<td>1.641</td>
<td>30</td>
<td>.054</td>
</tr>
<tr>
<td>India</td>
<td>191.593</td>
<td>700</td>
<td>.274</td>
<td>191.593</td>
<td>600</td>
<td>.319</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6.749</td>
<td>150</td>
<td>.045</td>
<td>6.749</td>
<td>130</td>
<td>.052</td>
</tr>
<tr>
<td>Nepal(1983)</td>
<td>2.841</td>
<td>15.1</td>
<td>.188</td>
<td>2.841</td>
<td>9.5</td>
<td>.299</td>
</tr>
<tr>
<td>Pakistan</td>
<td>4.277</td>
<td>71</td>
<td>.060</td>
<td>4.277</td>
<td>50</td>
<td>.085</td>
</tr>
<tr>
<td>Philippines</td>
<td>3.680</td>
<td>50</td>
<td>.073</td>
<td>3.680</td>
<td>40</td>
<td>.092</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>5.845</td>
<td>15.1</td>
<td>.387</td>
<td>5.845</td>
<td>8</td>
<td>.731</td>
</tr>
<tr>
<td>Thailand</td>
<td>13.860</td>
<td>47</td>
<td>.295</td>
<td>13.860</td>
<td>12</td>
<td>1.155</td>
</tr>
<tr>
<td>TOTAL</td>
<td>232.934</td>
<td>1,172</td>
<td>.198¹</td>
<td>232.934</td>
<td>868</td>
<td>.268¹</td>
</tr>
</tbody>
</table>

¹ N.B.: This crude mean is heavily weighted by data from India.

Trends and Comments on Funding

Thailand, India, Nepal allocate a large proportion of their health budgets to malaria control. All other countries are spending 10% or less of their health budgets on malaria control.

1. Thailand: Budget has been substantially increased annually, but at rate less than inflation.
2. India: Malaria control expenditures represent 22% of total health budget. Funding is 50%:50% arrangement between national government and the state governments. Funding has risen since 1979.
3. Nepal: During period 1977-80, malaria budget is 33-35% of total health budget.
4. Sri Lanka: Malaria budget is 10% of national health budget.
5. Indonesia: In spite of being about 10% of national health budget, malaria budget is quite austere.
6. Pakistan: In Five-Year Plan of Operation in 1975, malaria budget represented one-third of total health budget. This has decreased since then.
7. Burma: Budget for malaria is quite austere.
8. Bangladesh: Malaria budget figures cover unipurpose malaria workers. Expenditures for ACD, PCD, surveillance, etc. by multipurpose workers of ITHS are not broken out. Malaria budget has declined since 1979 (perhaps MHWs are supposed to take over more responsibilities?).
9. Philippines: According to AID/Manila, malaria budget is now fully integrated into the PHC budget and cannot be broken out for 1983.

POTENTIAL NEEDS FOR AID ASSISTANCE

Technical Assistance for specialized research needs
- Entomology using the latest immunological and biochemical techniques
- Drug therapy trials
- Rapid serological diagnostic techniques
- Support to and for village-based volunteer collaborator projects
  - initiate projects on model of Thailand
- Management and administration expertise

Operational Research
- Immunological effect of antimalarial interventions
- Entomology using the latest immunological and biochemical techniques
- Personal protection methods
- Biological control methods
- Computerization of data collection and analysis
- Development of epidemic warning system
- Larvicides and other antilarval strategies
- Insecticides as backups to failure of current materials
Training
- Support for training trainers through the Kuala Lumpur Secretariat
  - health education and other training
- Continue inputs in support of the National Training Center at Pra-buddhabhat, Thailand
  - training of trainers
  - transport and repair
  - equipment and supplies
- Extend training for senior staff
  - observation tours, if these can be controlled to assure usefulness
- Intersectoral exchanges (e.g., CDC, NIH) for researchers who have demonstrated ability to profit from such exchange
- Short-term consultancies coupled with bilateral research agreements to implement field research projects
- Longer-term overseas training fellowships for local researchers

Commodities
- Support to and for village-based volunteer collaborator projects and/or malaria clinics.
  - initiate projects on model of Thailand
  - further support for existing projects could focus on modest rewards and incentives, such as provision of new equipment, health education aids, and frequent resupply of good quality materials
- Insecticide support will be needed to continue spray programs in several countries
- There is continuing chronic need for equipment and materials, such as Landrovers, microscopes, etc.
BIBLIOGRAPHY - OVERVIEW


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria in Bangladesh has been reduced though not eliminated as a public health problem. There are two ecologically distinct transmission areas: 1) the hilly, forested, eastern and northern border areas where An. dirus (=An. balabacensis s.l.) is the major vector. An. minimus is a second vector in these areas. Most cases come from the Chittagong Hill Tracts (along the Burma-Bangladesh border), Bandarban, Chittagong, and Sylhet Districts (also, Mymensingh and Faridpur). Malaria is a severe focal problem in these areas of the country, with high incidence and periodic reports of deaths; 2) the central deltaic areas where rice is grown, An. philippinensis is the vector, and DDT spraying greatly reduced transmission. The majority of the population is at low risk, because malaria transmission in the deltaic plains was responsive to the intensive tactics employed during the 1960s. (1),(2)

Although not a countrywide problem, malaria transmission occurs in areas that have economic importance (tea production) and that attract non-immune settlers due to land pressure in other parts of the country (the government has also sponsored transmigration projects). The population of Bangladesh (90,000,000) is predominantly rural (91%), (1) and an estimated 8.5 million live in the high risk areas. (2)

In the forested hills, malaria transmission by An. dirus occurs during the monsoon season (June-September). In coastal areas, transmission by An. sundaicus generally commences in July and ends in December. (2)

Insecticide resistance has not been detected by susceptibility testing: It appears that malaria transmission by An. philippinensis and An. minimus was controlled before resistance emerged, and with An. dirus, its exophilic behavior, together with its excito-repellent behavior to DDT, diminish the selective pressure of DDT.

Chloroquine-resistant malaria was reported in 1976. (9)

HISTORY OF ANTIMALARIA ACTIVITY

During the 1950s, anti-larval measures and drug distribution were carried out in a limited number of areas. In 1961, a time-limited, phased malaria eradication program was launched (with the assistance of WHO and USAID) with steady success (except in the northern and eastern border areas). In 1971, the year of civil war and liberation, the program was greatly disrupted. Following liberation in 1972, huge importation of malaria cases resulted from the influx of returnees from malarious areas of India. (2),(1) The time-limited eradication program was abandoned for a long term program.

In 1977, the vertical MEP was merged with the Integrated Thana Health Complex Scheme (ITHS). A Plan of Operations was formulated in collaboration with WHO. That new strategy stratified the country into zones of high malaria risk (API>1) and low malaria risk. The high risk area was organized into 15 Malaria Zones with unipurpose malaria staff responsible for spray operations. In low risk areas, multipurpose health workers carried out surveillance and treatment. (2)
A new Plan of Operations (1982) has been formulated between the Government of Bangladesh and the WHO that defines three Strata: Stratum One - high malaria risk hilly districts; Stratum Two - intermediate areas; Stratum Three - low malaria risk plains.

**FIGURE 1.** Political boundaries of Bangladesh. The shaded areas are forested hills; these are the habitat of *An. dirus* and are hyperendemic for malaria.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Positives</strong></td>
<td>36,206</td>
<td>48,844</td>
<td>28,853</td>
<td>33,326</td>
<td>49,776</td>
<td>67,727</td>
<td>45,902</td>
<td>38,204</td>
<td></td>
</tr>
<tr>
<td><strong>No. Blood Films</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2,634</td>
<td>2,338</td>
<td>2,374</td>
<td>2,391</td>
</tr>
<tr>
<td><strong>No. Blood Films</strong></td>
<td>3,017</td>
<td>3,532</td>
<td>1,367</td>
<td>1,398</td>
<td>1,374</td>
<td>1,016</td>
<td>1,123</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>SPR</strong></td>
<td>1.2%</td>
<td>1.4%</td>
<td>2.1%</td>
<td>2.4%</td>
<td>3.6%</td>
<td>2.6%</td>
<td>1.9%</td>
<td>1.6%</td>
<td>-</td>
</tr>
<tr>
<td><strong>ABER</strong></td>
<td>4.1%</td>
<td>4.6%</td>
<td>1.6%</td>
<td>1.61%</td>
<td>1.59%</td>
<td>2.78%</td>
<td>2.4%</td>
<td>2.4%</td>
<td>-</td>
</tr>
<tr>
<td><strong>API</strong></td>
<td>0.49%</td>
<td>0.64%</td>
<td>0.38%</td>
<td>0.38%</td>
<td>0.38%</td>
<td>0.78%</td>
<td>0.51%</td>
<td>0.42%</td>
<td>-</td>
</tr>
<tr>
<td><strong>Malaria mortality</strong></td>
<td>No reliable mortality data at any level of the health structure is available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Population (million)</strong></td>
<td>86.546</td>
<td>89.143</td>
<td>90.625</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources:

N.B. Cable from AID/Dhaka mission states that accuracy of data is "suspect."
SCOPE OF MALARIA PROBLEM SINCE 1975

Malaria Morbidity

The data in Table 2-1 are compiled from several different sources that seem to be complementary. The number of malaria cases is from microscopically diagnosed blood slides.

There was a sharp drop in ABER, and in API, in 1977 when the integration plan was implemented. This was apparently due to confusion and lack of coordination among the health staff leading to decreased blood slide collection. Subsequently blood slide collection increased in pace with population growth (thus ABER was constant). However, the malaria cases detected increased sharply. This may have resulted from disrupted antimalaria activities, especially residual spraying.

In the WHO Statistics Annual (Table 15., Infectious Diseases, Annual Figures), malaria is ranked fourth in 1981 (45,902 cases) (Ill-Defined Intestinal Infections=328,752; leprosy=398,193; and tuberculosis=61,339). It is not clear if the detection and recording of each of these diseases is strictly comparable.

Malaria Mortality

No reliable malaria mortality data at any level of the health system is available. From the 1950s there is data to suggest 50,000 deaths and 1.5 million cases per year. There are reports of high mortality during 1982 among non-immune settlers in the Chittagong Hill Tracts; of two deaths in Ramgon4 and one death at Madhabpur Thana (Sylhet District) during 1981; and a number of deaths at Kalmakanda Thana (Mymensingh District) and Dharmapasha Thana (Sylhet District) during 1979. Reports of clinical malaria cases from hospitals and dispensaries for the whole country are also not available, and surprisingly, at the Thana Health Complex level malaria morbidity data are not available.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM

DEPARTURES FROM TRADITIONAL STRATEGIES

The vertical and semiautonomous eradication program has been replaced by a hybrid structure: the Integrated Thana Health Complex Scheme uses multipurpose health workers to provide village level health service, including collection of blood slides and presumptive treatment to suspected malaria patients. In areas of high malaria risk (10 districts), unipurpose malaria staff implement the residual spray program and provide focused attention on malaria supervision and surveillance.

Village Voluntary Collaborators (about 80) have been recruited, trained and placed in Chittagong Hill Tracts, primarily to distribute drugs. This scheme is to be expanded.

DELIVERY SYSTEM NOW IN USE

Structure and Staff

Malaria control activities are carried out in a hybrid arrangement of multipurpose health workers and unipurpose malaria workers. Under the plan of integration (1977), all basic field workers (e.g., Family Welfare Workers from
Figure 1-2
Technical and Administration Relationships between Antimalaria Component and General Health Services (HS) in the Integrated Thana Health Scheme (ITHS)

Director Health Services

- Assistant Director HS
  - Deputy Director HS (ITHS)
  - Deputy Director HS (Malaria)

Epidemiology
- Assessment
- Training
- Operation
- Entomology
- Parasitology

Deputy Director
- Divisional Malaria Officer (Dhaka & Chittagong)
  - Entomology
  - Operation
  - Parasitology

Civil Surgeon and Asst Civil Surgeon
- Epidemiology
- Entomology

Deputy Civil Surgeon
- Sub-division - 76

Assistant Civil Surgeon
- Thana - 469

- Parasitology
- Operations
- Training

- Health Inspector
  - Malaria
- Sanitary Inspector
- Squad Chief
- Family Welfare Workers
- Spraymen

* These personnel form one team with the Deputy Civil Surgeon (Malaria) whenever involved in antimalaria work.

integrated MCP, Government Health Assistants from Health Services, and Family Planning Assistants and Workers from Population Control) have been designated as multipurpose Health and Family Planning Workers, including malaria control activities (surveillance and treatment). Thus the majority of the former malaria workers have been integrated into the general health services as multipurpose workers, but there remains a unipurpose anti-malaria staff in the two Divisions with high malaria risk (Dhaka and Chittagong).

Under the 1977 Plan of Operations, the country was stratified into two zones of high malaria risk and low malaria risk. Under the 1982 Plan of Operations, a third intermediate category is added. Three Strata are defined: 1) First priority area - all forested border areas with An. dirus transmission of predominantly P. falciparum; 2) Second priority area - plain areas with An. philippinensis and An. sundaicus, with significant number of P.f. cases (either imported or indigenous); and 3) Third priority area - plain areas with An. philippinensis and only indigenous P. vivax.

At the national level, the Deputy Director of Health Services (Malaria and Parasitic Disease Control) is responsible for technical guidance, planning, evaluation, training and applied field research, but all aspects of implementation of malaria control activities are under the Director of Integrated Thana Health Complex at the national level, Civil Surgeons at District level, and Thana Health and Family Planning Officers at thana level.

At the Divisional level (four Divisions), there are Deputy Directors, Epidemiologists, and Entomologists, who monitor malaria among other diseases. In addition in the two high risk Divisions, there are two Divisional Malaria Officers and 15 Zonal Malaria Officers (Deputy Civil Surgeons) with responsibility for epidemiological investigations and supervision of unipurpose malaria staff who carry out spraying operations.

ACD/PCD

ACD is carried out by the Multipurpose Health Workers as part of their routine duties in regular monthly visits on fixed schedule. Unipurpose Malaria Workers in the high risk areas also conduct case detection and treatment. ACD in Statum 2 and 3 is conducted to maintain the gains achieved. Epidemiological investigation of all foci in these low risk areas is part of the ITHS activities.

In Stratum One, malariometric surveys of infants, children, or other appropriate groups are supposed to be carried out by the Unipurpose Malaria Workers.

PCD is carried out in all District and sub-divisional hospitals, Thana Health Complexes, dispensaries and union sub-centers. The positive case rate by PCD is 13 times higher than that detected through ACD, countrywide.

Method of Diagnosis and Coverage

Blood slides collected by multipurpose health workers are examined by laboratory technicians in the Thana Health Complexes (THC) and at district and sub-divisional levels in all areas. In the high risk areas additional laboratory services are provided at the malaria zone and division offices where blood slides taken by unipurpose malaria workers are examined.
The malaria zone laboratory slides are cross checked by the malaria division laboratory (10% of the negatives and all the positives). The THC laboratory slides are cross checked at the district level.\(^{(2)}\)

**Drug Protocols**

Radical treatment is given to both clinically and laboratory diagnosed cases. Primary treatment for uncomplicated \(P. falciparum\) is chloroquine (1500mg, divided over 3 days in a loading dose), plus primaquine (45 mg, divided evenly over 3 days). Second line of treatment, after therapeutic failure of chloroquine is sulfadoxine-pyrimethamine (Fansidar 3 tablets single dose), plus primaquine (45 mg, divided evenly over 3 days). Third line treatment of last resort is quinine (600mg tds for 3 days) plus tetracycline (250mg q.i.d. for 7 days).

Primary treatment for all \(P. vivax\) is chloroquine (1500 mg, divided over 3 days in a loading dose), plus primaquine (75 mg, divided evenly over 5 days).

In low risk areas, \(P. vivax\) cases are supposed to be followed up at 6 months with anti-relapse treatment (chloroquine 600mg and primaquine 15mg, for 5 days).

Presumptive treatment is given to suspected cases at blood slide collection.

Mass drug administrations may be carried out in localized epidemics (chloroquine, 600mg, plus primaquine, 30mg).

Chemoprophylaxis is targeted for regimented groups and new settlers in Chittagong Hill Tracts and Bandarban (chloroquine, 300mg, weekly). In chloroquine resistant areas, Fansidar (1 tablet) or Maloprim (1 tablet, dapsone 100mg and pyrimethamine 12.5mg) is to be substituted depending on availability.\(^{(2)}\)

**Spray Operations (frequency/insecticides used)**

Under the new Plan of Operations (1982), the strategy is two cycles of residual house spraying of DDT (2g/m\(^2\)) in Stratum 1, one pre-monsoon and one post-monsoon (increased from 1g/m\(^2\) previously, in high risk areas - API>1). In Stratum 2, one cycle only pre-monsoon. Focal spraying is planned for Stratum 2 and 3 as necessary. (Focal spraying was scheduled in low risk areas where the API rose above 1 per 1000 in the preceding year.)\(^{(2)}\)

In the high risk areas, the unipurpose malaria worker becomes the spray squad leader during the spray operations. The Health Inspector (Malaria) and Assistant Health Inspector (Malaria) are responsible for supervision.

**Type of Epidemiological and Entomological Data Available**

Epidemiological data on number of blood slides collected and diagnosis are available. Case investigation information is collected by Inspectors who investigate all \(P.f.\) cases and clusters of \(P.v.\) cases in the low risk areas.

Susceptibility status of the four vectors has been monitored, as well as vector density measurements to assess the impact of DDT spraying.\(^{(1,2)}\)
### Table 2-2
Houses Sprayed in Bangladesh
Spray Coverage (as percentage of targeted houses)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-monsoon Houses</td>
<td>-</td>
<td>46,161</td>
<td>500,827</td>
<td>1,025,697</td>
<td>770,146</td>
<td>851,873</td>
<td>814,552</td>
<td>724,659</td>
<td>-</td>
</tr>
<tr>
<td>cycle %</td>
<td>-</td>
<td>4.2%</td>
<td>44.0%</td>
<td>90.3%</td>
<td>23.0%</td>
<td>94.1%</td>
<td>87.3%</td>
<td>74.6%</td>
<td>-</td>
</tr>
<tr>
<td>Post-monsoon Houses</td>
<td>34,592</td>
<td>526,944</td>
<td>1,200,000</td>
<td>907,790</td>
<td>441,938</td>
<td>783,289</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>cycle %</td>
<td>3.2%</td>
<td>44.4%</td>
<td>90.0%</td>
<td>95.8%</td>
<td>67.1%</td>
<td>91.0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Focal spray Houses</td>
<td>85,199</td>
<td>9496</td>
<td>0</td>
<td>75,534</td>
<td>115,446</td>
<td>378,991</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>%</td>
<td>96.5%</td>
<td>97.0%</td>
<td>0</td>
<td>94.2%</td>
<td>99.4%</td>
<td>83.9%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Spraying in Zones 1, 3, and 4 not done.
2. Spraying in post-monsoon cycle was very limited due to shortage of DDT.

### Table 2-3
Population Protected by Residual Insecticide Spraying
Spray Coverage (as percentage of targeted population)

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-monsoon Pop.</td>
<td>-</td>
<td>254,911</td>
<td>2,708,315</td>
<td>5,669,729</td>
<td>3,791,253</td>
<td>4,469,809</td>
<td>4,314,841</td>
<td>3,802,894</td>
<td>-</td>
</tr>
<tr>
<td>cycle %</td>
<td>-</td>
<td>4.7%</td>
<td>46.8%</td>
<td>95.2%</td>
<td>19.0%</td>
<td>100%</td>
<td>92.2%</td>
<td>78.2%</td>
<td>-</td>
</tr>
<tr>
<td>Post-monsoon Pop.</td>
<td>151,730</td>
<td>2,965,540</td>
<td>5,400,000</td>
<td>4,805,569</td>
<td>2,511,727</td>
<td>4,118,161</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>cycle %</td>
<td>2.8%</td>
<td>51.3%</td>
<td>90.0%</td>
<td>96.3%</td>
<td>76.8%</td>
<td>83.6%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Focal spray Pop.</td>
<td>450,724</td>
<td>44,131</td>
<td>0</td>
<td>383,505</td>
<td>482,644</td>
<td>2,218,667</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>%</td>
<td>97.0%</td>
<td>98.1%</td>
<td>0</td>
<td>95.3%</td>
<td>95.6%</td>
<td>87.4%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Spraying in Zones 1, 3, and 4 not done.
2. Spraying in post-monsoon cycle was very limited due to shortage of DDT.

Training Programs (pre-service and in-service)
Training courses in malaria control are conducted, for Civil Surgeons and Deputy Civil Surgeons, and Thana Health Administrators (Assistant Civil Surgeons). (1)

Operations Research (in-house, universities, etc.)
In the 1982 Plan of Operations, field research on monitoring of drug resistance (chloroquine, mefloquine, quinine, Fansidar) by invitro and invivo methods is planned to continue. A study of the extent and severity of glucose-6-phosphate dehydrogenase (G6PD) deficiency as a problem is planned. Entomological data on the impact of spray operations, status of insecticide resistance continue. (2)

ANALYSIS OF OPERATIONAL PROBLEMS
INSECTICIDE RESISTANCE
Insecticide resistance is not a problem in Bangladesh. DDT-susceptibility tests on An. dirus (=An. balabacensis s.l.) have shown this vector remains sensitive to DDT. (4) This is not surprising given the continued susceptibility of this species complex throughout its range in southeast Asia, probably due to its excito-repellant avoidance behavior in the presence of DDT and exophilic/exophagic behavior, which limit the selection pressure.

The other three vectors, An. philippinensis, An. minimus, and An. sundalis have also been tested susceptible to DDT. (1), (3)

VECTOR BEHAVIOR
Vector behavior is a major problem in the highly malarious forest zones where An. dirus exhibits an excito-repellant avoidance behavior to DDT and also shows partial exophily and exophagy. (1) Thus residual house spraying is not effective in reducing vector longevity. Furthermore, this vector breeds in small puddles and other collections of fresh rainwater that collect during the monsoon season, making larval control problematic.

A change in the behavior pattern of An. philippinensis is reported (unspecified change). A change in spraying strategy is reported (increased frequency and concentration of spraying: it is not clear whether this indicates resistance).

SPRAY COVERAGE
The high risk areas for regular residual spraying were identified in 1976. No changes were made until the 1982 Plan of Operations. The identification of areas for focal spraying was based on API, but the ABER produced by the surveillance mechanism during the period 1978-1982 has been extremely low, therefore, there is doubt as to the accuracy of the APIs. (2)

In recent years, availability of insecticide and logistics have been the basis for targeting of areas for insecticide application, rather than epidemiological considerations. (2)

DRUG RESISTANCE
Chloroquine-resistant *P. falciparum* has become a major problem. The first report came in 1976.\(^9\) The high risk areas are the border areas and 5 miles into Bangladesh territory, and especially, Chittagong Hill Tracts, Chittagong and Sylhet Districts. Most tests have indicated RI and RII response, but RIII response has been found in Comilla, Chittagong and the Chittagong Hill Tracts.\(^1\)

Fansidar (sulfadoxine-pyrimethamine) is used as a second line treatment, after therapeutic failure of chloroquine. Quinine (x3 days) cum tetracycline (x7 days) is the third line treatment, thus sulfadoxine-pyrimethamine treatment failure must be occurring.

**QUALITY OF DIAGNOSTIC WORK**

It is reported that when eradication was replaced by a long-term program in the early 1970s, the reorganization destroyed morale.\(^2\) Many highly skilled technicians saddled with new health care responsibilities felt unappreciated. Pay remained poor. Consequently many left government service for the private sector or the Middle East.

**QUALITY OF ENTOMOLOGICAL DATA**

As with diagnostic work above, entomological work suffered from reorganization during the 1970s. A number of skilled staff left government service, with a remainder posted in Dhaka headquarters. Lack of mobility causes underutilization of district entomological teams. The field work is not well-checked.\(^2\) Lack of adequate supervision is blamed on shortage of transport and inadequate travel allowances.\(^1\)

**QUALITY OF EPIDEMIOLOGICAL DATA**

Cases are reported by date of blood slide examination, rather than of blood slide collection.\(^2\) Thus, epidemiological data are not indicative of transmission seasons. Because many residents of the hilly, forested transmission areas are asymptomatic by semi-immunity, prevalence and incidence are greatly underestimated by ACD and PCD.

**QUALITY OF TRAINING PROGRAMS**

Little information was available. There is no specific national budgetary allocation for inservice and refresher training. It is inferred that training is weak. Given the organizational problems, it is noted that training is lost on people with no place to use it or pressure to use it.

**OTHER PROBLEMS**

The increase in number of malaria cases in Chittagong during 1979-80 was attributed to mass population movements as well as the establishment of a refugee camp in the high risk areas.\(^2\) Non-immune populations move into the highly malarious areas of Chittagong Hill Tracts leading to increased SPRs and also deaths.\(^1\)

There is no clear and distinct line of command, especially at district and thana levels, but also between the Deputy Director (Malaria and Parasitic Disease Control) and Civil Surgeons of the districts, now that integration of health and family planning services has been implemented.\(^2\)
Laxity of implementation of MCP guidelines at district level results in the low rate of blood slide collection.\(^{(1)}\)

Lack of adequate supervisory control of peripheral health workers by the different district and thana organization echelons.

Lack of adequate field supervision is also blamed on shortage of transportation and inadequacy of travel allowances.\(^{(1)}\)

Lack of coordination between the Health Sector and other Sectors, e.g., resettlement schemes in Chittagong Hill Tract, delay in tender procedure and clearance of supplies, inadequate storage facilities in the periphery.

Shortage of good quality DDT because of limited imports from abroad, low production, and poor quality control of DDT domestically manufactured.

Delay in filling vacancies resulting in 40% vacancy rate in corps of peripheral health workers.

Lack of uniformity in pay scales between different health workers leading to dissatisfaction.
### Table 2-4
Malaria Program Financing

<table>
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</thead>
<tbody>
<tr>
<td>Host Government (revenue budget)</td>
<td>-</td>
<td>$1,080,000</td>
<td>$1,372,000</td>
<td>$808,000</td>
<td>$848,000</td>
</tr>
<tr>
<td>(Tk.27.0 mill)</td>
<td></td>
<td>(Tk.34.3 mill)</td>
<td>(Tk.20.2 mill)</td>
<td>(Tk.21.2 mill)</td>
<td></td>
</tr>
<tr>
<td>Donors (WHO and ADB)</td>
<td>-</td>
<td>$2,508,000</td>
<td>$1,824,000</td>
<td>$2,528,000</td>
<td>$1,600,000</td>
</tr>
<tr>
<td>(Tk.62.7 mill)</td>
<td></td>
<td>(Tk.45.6 mill)</td>
<td>(Tk.63.2 mill)</td>
<td>(Tk 40.0 mill)</td>
<td>(est.)</td>
</tr>
<tr>
<td>AID</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>$3,588,000</td>
<td>$3,196,000</td>
<td>$3,336,000</td>
<td>approx.$2,448,000</td>
</tr>
</tbody>
</table>

Exchange Rate: Taka 25=US$1

1 These sums cover anti-malaria activities by the Unipurpose Malaria Workers. Costs of anti-malaria activities (ACD, PCD, treatment) carried out by Multipurpose Health Workers of ITHS cannot be broken out of ITHS expenditures.

STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

Bangladesh is a poor country that will require external assistance for the foreseeable future. There is a need for an externally aided program with a multi-annual commitment, in order to assure the stability of the program. However, the lack of clear and distinct lines of command now that integration of health services has been implemented, but not successfully, have left the antimalaria program needing better administration to be effective.

POTENTIAL NEEDS FOR AID ASSISTANCE

Commodity support
- insecticide

Donor coordination conference to review GOB Plan of Operation

Training
- short and long term
- internal training courses and external traineeships

Operational research
- epidemiologic and entomologic investigations
- in 1978, a research proposal was considered but not funded to test the feasibility of antilarval measures in a tea plantation, based on previous observations of feasibility.

Technical assistance
- operational research techniques

Program planning/design/evaluation
- integration of malaria control into Thana Health Complex Scheme is committed goal of government, but needs care, thought, and planning

Management analysis - transport, supplies, logistics, reporting
BIBLIOGRAPHY - BANGLADESH


7. Rosenberg R (1978), untitled manuscript of research project proposal in Chittagong Hill Tract.


BIBLIOGRAPHY - BANGLADESH


7. Rosenberg R (1978), untitled manuscript of research project proposal in Chittagong Hill Tract.


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria transmission in Burma occurs in rural areas, thus affecting the majority of the population. Malaria is highly prevalent in the hilly forest regions (vectors: An. minimus, An. dirus [-An. balabacensis s.l.]), in the coastal regions (vector: An. sundaicus), the coastal plains (vector: An. annularis). Malaria also occurs in irrigated areas of the dry central plains (vector: An. culicifacies), while in the rest of the dry zone, the southern plains and deltaic regions, malaria is of low prevalence. (1)

It is reported that in spite of a low ABER, malaria detection increased during the 1970s (SPR and API rose), as did deaths due to malaria. (4) Approximately 25% of the population live in remote areas which are not covered by active anti-malaria activities and thus not included in any statistics. (4) DDT resistance has appeared in An. culicifacies and An. annularis. Chloroquine resistance was identified in field studies starting from 1971. Sulfadoxine-pyrimethamine resistance is frequently encountered and increasing. (12), (14)

HISTORY OF ANTIMALARIA ACTIVITY

Before 1950, antilarval measures and drug distribution in a limited number of sites were carried out. In 1953, a countrywide malaria control program using DDT residual spraying was initiated. In the early 1950s, FAO (predecessor of AID) provided support until political upheaval led to termination of US assistance. There were brief experiments with spraying by village volunteers, and then by the Burmese army. In 1957, the program became a malaria eradication program, following the WHO model, but did not achieve its goal. Recognizing operational constraints and limited financial resources, the time-limited MEP was reconverted into a malaria control program in 1972. That vertical program operated until 1976, when a Vector-borne Disease Control Program (VBDC) was established within the People's Health Plan. (15)

The VBDC program combined the previous vertical programs for malaria, dengue hemorrhagic fever, filariasis, Japanese encephalitis, and plague.

SCOPE OF MALARIA PROBLEM SINCE 1975

Malaria Morbidity and Mortality

All sources mention the high importance of malaria as a public health problem in Burma. There have been from 400,000 to 800,000 clinical malaria cases recorded during each of the past seven years.

Burmese statistics (2) are cited in a recent AID report (13) that show malaria as the leading cause of admission to hospitals, and the leading cause of death in hospitals in 1977.

In the WHO Statistics Annual 1983 (Table 15. Infectious Diseases, Annual Figures), (16) malaria is the most prevalent condition listed. The actual number of cases listed obviously indicates an underreporting error (1979-8,471 cases, 1980-10,880 cases, 1981-10,783; these totals are substantially lower than figures given later in the same publication and listed below in Table 3-1.), but the relative ranking of malaria is probably correct.
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Total Clinical Cases(^1,4)</td>
<td>-</td>
<td>-</td>
<td>609,161</td>
<td>395,876</td>
<td>470,035</td>
<td>830,645</td>
<td>718,290</td>
<td>-</td>
<td>672,036</td>
</tr>
<tr>
<td>Total Malaria Cases(^2)</td>
<td>11,871</td>
<td>10,003</td>
<td>13,195</td>
<td>12,485</td>
<td>14,515</td>
<td>16,469</td>
<td>42,019</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total Positives(^3)</td>
<td>-</td>
<td>-</td>
<td>*16,206(^6)</td>
<td>*16,806(^6)</td>
<td>*23,506(^6)</td>
<td>-</td>
<td>*35,306(^6)</td>
<td>-</td>
<td>*40,406(^6)</td>
</tr>
<tr>
<td>No. Blood Films(^1)</td>
<td>-</td>
<td>-</td>
<td>345,554</td>
<td>331,868</td>
<td>285,232</td>
<td>472,687(^7)</td>
<td>526,365</td>
<td>-</td>
<td>961,914</td>
</tr>
<tr>
<td>SPR</td>
<td>3.3(^3)</td>
<td>4.0(^3)</td>
<td>4.7(^1)</td>
<td>5.0(^3)</td>
<td>8.2(^4)</td>
<td>7.7(^1)</td>
<td>6.7(^1)</td>
<td>-</td>
<td>4.2(^1)</td>
</tr>
<tr>
<td>API (permille)</td>
<td>-</td>
<td>0.5(^4)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.72(^4)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>ABER (slides/100 pop)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(%P.falciparum)</td>
<td>-</td>
<td>65(^4)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>No. of (P.f.)</td>
<td>-</td>
<td>-</td>
<td>417,275</td>
<td>296,511</td>
<td>386,838</td>
<td>680,298</td>
<td>596,890</td>
<td>-</td>
<td>588,031</td>
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<tr>
<td>No. of (P.a.)</td>
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<td>-</td>
<td>189,449</td>
<td>98,177</td>
<td>79,905</td>
<td>145,362</td>
<td>125,700</td>
<td>-</td>
<td>80,644</td>
</tr>
<tr>
<td>Deaths(^1,6)</td>
<td>-</td>
<td>-</td>
<td>936</td>
<td>917</td>
<td>1282</td>
<td>2120</td>
<td>1718</td>
<td>-</td>
<td>1774</td>
</tr>
<tr>
<td>Population (million)</td>
<td>30.2(^3)</td>
<td>32.6(^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources:
1. USAID (1984), cable from AID/Rangoon mission.

Notes:
6. Total positives were computed using the reported SPR and the total number of blood films examined.
7. This figure was garbled in the cable.
8. These are deaths in clinically diagnosed malaria.
REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM
DEPARTURES FROM TRADITIONAL STRATEGIES AND TACTICS

One part of the general strategy of the vector-borne disease control program is the use of bio-environmental measures, such as bonification of breeding sources, use of larvivorous fish, and planting of trees near breeding sites (where the vector prefers a sunny habitat), when feasible. Reforestation has been brought to the attention of the National Forestry authorities.

DELIVERY SYSTEM NOW IN USE
Structure and staff

The People's Health Plan of Burma has individual programs to cover the major health areas (primary health care and basic health services; environmental sanitation; expanded program of immunization; family health; medical and surgical care; and vector-borne disease control) and support services (laboratory services; health information services; supply and logistical services; biological standardization and quality control; repair and maintenance; and staff development and training).

For vector-borne disease control there is a general strategy to be applied, that includes: control of vector breeding through bio-environmental methods and general sanitation; active community participation and health education; surveillance (case detection and treatment); insecticidal measures (residual spraying and larviciding).

Malaria is identified as Burma's most important health problem and ongoing antimalaria activities include: surveillance, DDT residual spraying, and provision of drugs. At the national level, the director of the VBDC program and his staff are responsible for planning the malaria program, monitoring progress, evaluation and assessment, training, research, epidemiological surveillance, procurement and distribution of supplies, and special surveys.

At the state and divisional levels, health personnel are under the administration of the Health Director of the division or state. Still the VBDC units carry out the various malaria activities in step with the national VBDC staff.

At the township level, the VBDC units consist of malaria supervisor, several field workers, and temporary spraymen, with responsibility for organization of bio-environmental and general sanitation measures, residual DDT spraying and larviciding, ACD and treatment of malaria cases, epidemic control, larval surveys, disease and vector surveillance, and reporting.

Malaria laboratory staff are not integrated, but redeployed in state and division laboratories under the pathologist.

In spite of the seeming "integration" of malaria control activities into the general health system, the malaria control activities seem to be functioning by unipurpose workers. The country is stratified into five strategic zones.
Fig. 3.1. Map showing Anti-malaria Programme in Burma: Areas under various control activities in 1981.


1) **Areas under control by wide availability of drugs**
   These areas have high malaria prevalence but difficult access and poorly developed health infrastructure. Antimalaria tactics: Suppressive treatment, chemoprophylaxis to vulnerable groups, PCD, and selective spraying in development projects and in response to epidemic outbreaks.

2) **Areas under control by spray**
   These areas have high malaria prevalence, good accessibility, vector susceptibility to insecticides, and good health infrastructure. Antimalaria tactics: regular residual spray, suppressive treatment, PCD, chemoprophylaxis to migratory workers.
3) **Areas under control by surveillance**
These areas have low malaria prevalence, as a result of previous antimalarial activities, good accessibility, and well developed health infrastructure. Antimalaria tactics: ACD, PCD, radical treatment, selective focal spraying in response to epidemic outbreaks.

4) **Areas under control by vigilance**
These areas have low malaria prevalence, without any indigenous cases for two successive years, a well developed health infrastructure and good accessibility. Antimalaria tactics: ACD, PCD, radical treatment, case investigation, selective focal spraying in response to outbreaks.

5) **Areas without any active antimalaria measures**
These are the large cities (Rangoon, Mandalay) where malaria was never prevalent or disappeared without antimalaria measures. PCD and radical treatment are used to deal with any cases (imported from malarious areas).

**ACD/PCD**

ACD is carried out by taking blood smears from fever cases during house to house visiting in surveillance areas. Single dose presumptive or suppressive treatment is administered.

PCD is carried out by collection of blood smears and administration of drugs at rural health centers and hospitals.

**Method of Diagnosis and Coverage**

The diagnosis of most malaria is reported as a clinical diagnosis and is not necessarily confirmed by laboratory diagnosis. There are malaria microscopists, and blood slides are collected, but the exact procedures and constraints are not clear from the available reference materials.

**Drug Protocols**

Radical treatment is given to parasitologically confirmed cases. (1)

Treatment of clinically suspected cases or parasitologically confirmed cases admitted into hospitals depends upon the clinical condition of the patient and parasitological findings. (1) Cerebral malaria is being treated with quinine (i.v.)

Suppressive treatment by single dose antimalarials is given to clinically suspected malaria cases.

Chemoprophylactic administration of antimalarials is used weekly or fortnightly during the transmission season to children (6 months to 14 years), pregnant and nursing mothers, some agricultural workers from villages of high morbidity in high endemic areas and migratory workers from low prevalence areas. (1)
 Spray Operations (frequency/insecticides used)

Limited residual spraying of DDT (2g/m²) is applied to houses and out-
houses annually, just before the onset of the transmission season.(1)

Focal spraying of DDT is carried out in certain priority areas (develop-
ment projects) or in cases of epidemic outbreak.(1) This tactic is replaced
by other approaches depending upon the epidemiological situation.

Type of Epidemiological and Entomological Data Available

Blood slides are not collected from all suspected malaria cases. There-
fore species data, as well as the actual number of malaria cases, is suspect.
In addition, as much as 25% of the population may live in remote areas that
are not within the area of coverage by the health system.

Drug susceptibility data is available and reliable.

The entomological data available is from insecticide susceptibility
tests.

Training Programs (pre-service and in-service)

There is a modest health training center in Rangoon.

The following training courses have been given in the past in Burma:(15)

1) Epidemiology and control of vector-borne diseases (6 weeks) - for
township medical officers and assistant physicians (hospital), partic-
ularly those from malarious areas. A basic malariology course.
[This course may not have been given since 1976.]

2) Vector-borne disease control (4 weeks) - for health assistants (para-
medical head of a rural health center) and malaria assistants (posted
at divisional or township level in malarious areas). A basic malari-
ology course with emphasis on prevention and control measures at the
expense of epidemiology and data collection and presentation. Field
and practical training included.

3) Malaria microscopy (3 weeks) - a required course in the two-year cur-
riculum leading to the Diploma in Paramedical Science - Medical Tech-
nology.

4) Refresher training for malaria assistants and malaria inspectors (the
later posted at township level) - courses on various aspects of oper-
ational malaria control (geographical reconnaissance and spraying,
spayer repair, anti-larval and bio-environmental control measures)
were given on less than an annual basis.

5) Field training of subordinate categories of personnel - the malaria
inspector (township level) trains the malaria supervisor (rural
health level). The malaria inspector (public health supervisor Grade
II) together with the township medical officer trains the community
health workers and the auxiliary midwives who are volunteer workers.

In addition, post-graduate medical students for the Diploma in Preventive
and Tropical Medicine receive 40 hours of malaria instruction. Undergraduate
senior medical students receive 10-12 hours of malaria instruction (in two of
the three Burmese medical schools). Intermediary university students receive
two hours of malaria instruction as part of a required family health course.
Operations Research (in-house, universities, etc.)

Field research activities are carried out under the responsibility of the Department of Medical Research of the Institutes of Medicine, the Department of Health (VBDC), and the Defence Medical Services.\(^{15}\) There is a coordinating committee of malaria research. The agenda of research listed by the WHO\(^{15}\) includes drug susceptibility testing, insecticide resistance testing, studies of vector species complexes, transmission dynamics, alternative control measures.

A malaria research team has recently been established in Taunggyi to study severe malaria with a WHO consultant.

**ANALYSIS OF OPERATIONAL PROBLEMS**

**INSECTICIDE RESISTANCE**

Insecticide resistance is a moderate to major problem. In the forested hills, where most malaria occurs, the vectors are still susceptible to insecticides. In the central plains, *An. culicifacies* is resistant to DDT. In the coastal plains, *An. annularis* is resistant to DDT.

**VECTOR SUSCEPTIBILITY**

<table>
<thead>
<tr>
<th>Vector</th>
<th>Susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>An. annularis</em></td>
<td>DDT resistant (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. culicifacies</em></td>
<td>DDT resistant (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. culicifacies</em></td>
<td>Malathion sensitive (5.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. culicifacies</em> (Pegu)</td>
<td>Fenitrothion resistant (1.0%, 2 hr)</td>
</tr>
<tr>
<td><em>An. culicifacies</em> (Mandalay)</td>
<td>Fenitrothion sensitive (1.0%, 2 hr)</td>
</tr>
<tr>
<td><em>An. balabacensis</em></td>
<td>DDT partially sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. minimus</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. minimus</em></td>
<td>Dieldren sensitive (0.4%, 1 hr)</td>
</tr>
<tr>
<td><em>An. sudaicus</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. sudaicus</em></td>
<td>Dieldren sensitive (0.4%, 1 hr)</td>
</tr>
<tr>
<td><em>An. jamesi</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. jamesi</em></td>
<td>Dieldren sensitive (0.4%, 1 hr)</td>
</tr>
<tr>
<td><em>An. jamesi</em></td>
<td>Fenitrothion sensitive (1.0%, 2 hr)</td>
</tr>
<tr>
<td><em>An. maculacus</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. maculacus</em></td>
<td>Fenitrothion sensitive (1.0%, 2 hr)</td>
</tr>
<tr>
<td><em>An. hyrcanus</em></td>
<td>DDT resistant/partially resistant (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. hyrcanus</em></td>
<td>Malathion sensitive (5.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. philippinensis</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. stephensi</em></td>
<td>DDT sensitive (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. nigerrimus</em></td>
<td>DDT resistant/partially resistant (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. vagus</em></td>
<td>DDT resistant (4.0%, 1 hr)</td>
</tr>
<tr>
<td><em>An. subpictus</em></td>
<td>DDT resistant (4.0%, 1 hr)</td>
</tr>
</tbody>
</table>
VECTOR BEHAVIOR

Vector behavior is a moderate problem. *An. dirus*, an important vector in the hilly forest areas, is exophilic and exophagic making residual spraying less effective against it, and it also avoids DDT deposits. Furthermore, its breeding sites, small pools of water in the dense jungle, make larval attack problematic, although clearing of shade cover at development sites has led to reduced densities.\(^1\)

*An. sundaicus* is the vector in coastal areas of Arakan State, the Lower Delta, and Tenasserim. It breeds in various pools of brackish water subject to tidal fluctuation, especially collecting seasonally behind sandbars. Where the breeding sites are high-tide pools that can be mapped, chemical larviciding is feasible, but in most cases, larval control is difficult to implement and hardly effective, because the bodies of water are estuaries and marshy mangrove belts.

The other vectors do not present behavior problems:

*An. minimus* is the other important vector in the forested hills. It breeds in sunny, slow-running, shallow, grass-edged streams, seepages, rice fields, and forest fringes. Residual DDT spraying is effective in reducing malaria prevalence transmitted by *An. minimus*.\(^1\)

*An. annularis* is the vector in the Arakan coastal plain. It breeds in stagnant waters like large tanks, ponds, and borrow pits, and also in wet rice fields.

*An. culicifacies* is the vector in Central Burma, especially irrigated areas. It breeds in stagnant pools of slow-running fresh water, also in pools of clear rain water, and in early rice fields.

SPRAY COVERAGE

The spray program in Burma is relatively modest. Large rural areas with transmission are not covered due to remoteness combined with budgetary constraints. (See Table 3-2.)

DRUG RESISTANCE

Drug resistance is a major problem. *P. falciparum* resistant to chloroquine and sulfadoxine-pyrimethamine (Fansidar) has been reported from 13 of the 14 states/divisions (with no studies yet in the excepted state [Kayah]).\(^12\),\(^14\) Thus, the primary and secondary drugs of choice have lost effectiveness against the most serious species of malaria, which is predominant in Burma.

Studies during the 1970s reported widespread resistance to chloroquine and amodiaquine, and pyrimethamine and proguanil.\(^10\) Recent studies have indicated a high prevalence of chloroquine resistant malaria at the RIII level.\(^9\)

A large field trial in 1980 recorded an RI type response to sulfadoxine-pyrimethamine (Fansidar) and an RIII type response to sulfalene-pyrimethamine.\(^11\)

A recent study of single-dose mefloquine therapy showed it to be effective for treatment of *P. falciparum* infections.\(^12\)
Table 3-2.
Spray Coverage
No. of Houses Sprayed

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Houses</td>
<td>452,000</td>
<td>405,000</td>
<td>380,000</td>
<td>447,000</td>
<td>616,000</td>
<td>631,000</td>
<td>633,000</td>
<td>600,000</td>
</tr>
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</table>


Percent coverage is not given in data supplied to AID/Washington.

Program Financing

Table 3-3.
Malaria Program Financing

<table>
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<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Host Government</td>
<td>$629,690</td>
<td>$555,980</td>
<td>$609,908</td>
<td>$711,322</td>
<td>$704,485</td>
<td>$908,761</td>
</tr>
<tr>
<td>SIDA (Swedish)</td>
<td>0</td>
<td>479,437</td>
<td>999,425</td>
<td>731,434</td>
<td>813,937</td>
<td>550,000</td>
</tr>
<tr>
<td>WHO</td>
<td>37,929</td>
<td>84,811</td>
<td>300,000</td>
<td>326,200</td>
<td>122,810</td>
<td>147,098</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0</td>
<td>0</td>
<td>146,800</td>
<td>138,500</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>UNICEF</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total | $667,619 | $1,120,228 | $2,056,133 | $1,907,456 | $1,641,232 | $1,605,859 |

In U.S.$

QUALITY OF DIAGNOSTIC WORK
Specific information was not available to judge this. However, general comments indicate the Burmese staff are apt and conscientious.

QUALITY OF ENTOMOLOGICAL DATA
Specific information was not available to judge this. However, general comments indicate the Burmese staff are apt and conscientious.

QUALITY OF EPIDEMIOLOGICAL DATA
Specific information was not available to judge this. However, general comments indicate the Burmese staff are apt and conscientious.

QUALITY OF TRAINING PROGRAMS
Specific information was not available to judge this. However, general comments indicate the Burmese staff are apt and conscientious.

OTHER PROBLEMS
No specific information was available.

STRATEGY OVERVIEW FOR AID ACTION
UNMET NEEDS
The Burma anti-malaria program is extremely modest due to austere economic conditions. There are extensive areas in the hinterland that have no active antimalaria measures.

POTENTIAL NEEDS FOR AID ASSISTANCE
AID is funding a project to assist primary health care in Burma. Parts of the project are to develop a health information system, with computerization of statistics, and to provide training in epidemiology and environmental sciences, among other topics. The VBDC unit (including malaria) is not specifically targeted. Perhaps this could be implemented.

Training
- for higher level staff to perform operational research
- support of local training for both malaria/vector-borne disease staff and other public health staff
- material support for training center in Rangoon

Technical assistance
- vector control measures
- entomologic research

Operational research
- support for study of environmental measures against malaria
- monitoring of insecticide susceptibility
BIBLIOGRAPHY - BURMA


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

The whole of India is at some risk of malaria transmission, except for mountainous areas above 5,000 feet and some coastal plains. Serious malaria incidence occurs in several different States, each of which is as big as other countries in the region. The vast size of the subcontinent and the huge population (700,000,000 in 1982), with great variety of geographic and demographic conditions, make the malaria control problem immense. The National Malaria Eradication Programme (NMEP) of India was the largest in the world. (23)

From near eradication in the mid-1960s (100,000 cases in 1965), malaria rose to 6.5 million in 1976 (with an estimated 3-4 times that number undetected). It has since declined to 1.2 million in 1983, after re-institution of budget, administrative, and operational emphasis through the Modified Plan of Operations (MPO) that was launched in April 1977. The objectives are: 1) elimination of deaths from malaria, 2) reduction in malaria morbidity, and 3) maintenance of gains achieved, by reduction of transmission wherever possible, and by chemotherapy. (12) Antimalarial activities have been integrated into the general health services. A program to make chloroquine widely available for presumptive treatment is implemented by a corps of village-level volunteers.

The principal rural vector An. culicifacies and the principal urban vector An. stephensi are both highly resistant to DDT and HCH. Malathion resistance in An. culicifacies is also wide spread. Drug-resistant P. falciparum has spread widely since first recognized in 1973.

HISTORY OF ANTIMALARIA ACTIVITY

In the late 1940s, pilot project studies were conducted with DDT residual spraying. India launched the National Malaria Control Program (NMCP) in 1953. It was converted to the National Malaria Eradication Program (NMEP) in 1958, following the WHO eradication strategy. During the period 1958-65, dramatic reduction in the incidence of malaria was recorded in most of India (less than 100,000 cases and no deaths in 1965, as compared to an estimated 75 million cases and 800,000 deaths reported annually in the pre-program period). (30), (23)

With the vast reduction in malaria incidence, the intensive tactics were relaxed, health program priorities were shifted to family planning, smallpox eradication, and the multipurpose health worker scheme, and budget funds were shifted. However, the malarialogic potential of many areas remained high. The malaria situation deteriorated disastrously. Transmission increased rapidly without a quick and effective response. Within 2-3 years, consolidation and maintenance phase areas (with population of over 90 million) had to be reverted to attack phase (intensive residual spraying). This epidemic upsurge was due to inadequate budgets, lack of management attention, and lack of early response. Malaria incidence had risen to 6.5 million cases (microscopically confirmed) in 1976. (30)

Insecticide resistance in the principal vectors became a factor early in the NMEP. In 1962-63, HCH (lindane) was substituted due to DDT resistance in An. culicifacies. Malathion was substituted for HCH in 1968-69, and this was extended as DDT and HCH resistance spread.
The Modified Plan of Operations (MOP) was implemented in 1977, based on continued residual insecticide spraying and simplified surveillance in rural areas, without the eradication terminology. The importance of the MOP was as a focus of revitalized antimalaria effort with increased funding. Wide and free availability of chloroquine has been promoted by the establishment of Drug Distribution Centers (DDCs) and Fever Treatment Depots (FTDs) staffed by village volunteers, as well as by the Primary Health Centers. There is also the Community Health Volunteer (CHV) program, and the Multipurpose Worker Scheme (MPWS) begun in 1981.(30),(25)

Malaria has also resurfaced in urban areas (vector - *An. stephensi*).

Figure 3-1.
Map of India
Table 4-1.

No. of Malaria Cases Recorded
No. of Blood Films Examined
Slide Positivity Rate (SPR)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Positive</td>
<td>-</td>
<td>6,467,215</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2,753,217</td>
<td>2,227,826</td>
<td>1,613,087</td>
<td>1,157,385</td>
</tr>
<tr>
<td>Blood Slides</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Positive*</td>
<td>5,166,142</td>
<td>6,467,215</td>
<td>4,740,900</td>
<td>4,144,385</td>
<td>3,064,697</td>
<td>2,844,815</td>
<td>2,666,244</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Blood Slides</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Ex.</td>
<td>-</td>
<td>58,390,296</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>46,250,942</td>
</tr>
<tr>
<td>SPR</td>
<td>-</td>
<td>11.1%</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.4%</td>
</tr>
<tr>
<td>SPR*</td>
<td>-</td>
<td>10.2%</td>
<td>11.1%</td>
<td>8.2%</td>
<td>7.2%</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>API</td>
<td>-</td>
<td>3.9%</td>
<td>10.9%</td>
<td>7.5%</td>
<td>6.8%</td>
<td>-</td>
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<tr>
<td>ABER*</td>
<td>-</td>
<td>8.9%</td>
<td>9.1%</td>
<td>9.5%</td>
<td>9.9%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>XP*</td>
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<td>14.1%</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>20.9%</td>
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<tr>
<td>No. of P.F.</td>
<td>729,251</td>
<td>753,713</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>337,742</td>
<td>252,726</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Malaria Deaths</td>
<td>99</td>
<td>59</td>
<td>55</td>
<td>74</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Population (million)</td>
<td>594.6</td>
<td>700.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Sources:
1. USAID (1984), cable from AID/New Delhi mission.
6. *estimated from a graph

N.B.: Data for 1983 in respect of West Bengal and Bihar is incomplete.
SCOPE OF MALARIA PROBLEM SINCE 1975
Malaria Morbidity and Mortality

Following the disastrous resurgence of malaria in the mid-1960s, intensified antimalaria measures were reinstituted. Since 1975 there has been a steady decline of malaria incidence. The available data is believed to seriously underestimate the actual incidence, but it can be used for comparative purposes over time. Reliable mortality data is unavailable.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM
DEPARTURES FROM TRADITIONAL STRATEGIES

The NMEP has been integrated into the general health services. Several different categories of peripheral health workers are responsible for surveillance and chemotherapy, including multipurpose health workers and an extensive network of village-level volunteers who maintain Drug Distribution Centers or Fever Treatment Depots.

Larviciding with temephos (Abate) and ULV fogging in urban areas began during the life of a recent USAID malaria control loan (Project No. 386-0455, 1978-83, $38,000,000). Abate larviciding is reported to be very popular with State officials, because of effectiveness, and cost benefit over oil and other larvicides. After using USAID-supplied ULV fogging units, a number of States have purchased them. The long-term value is presumably in control of epidemics.

DESCRIPTION OF DELIVERY SYSTEM NOW IN USE
Structure and Staff

The former vertical line of administrative and technical control in the NMCP/NMEP is now a horizontal structure. At the State and Zonal level, unipurpose malaria officers supervise. At the District and Primary Health Center level, unipurpose workers (District Malaria Officer, Assistant Malaria Officer, Malaria Inspector) supervise the quality of the work by Multipurpose Health Workers (MHW) implementing the directives of all the National Health Programs (including malaria) at the periphery. Planned coverage is one MHW per 5000-7000 population, but currently stands at 1 per 10,000 population.

The MOP seeks the active participation of the people served. Approximately 360,000 Drug Distribution Centers (DDC) and Fever Treatment Depots (FTD) have been established, which are run by village volunteers. DDCs dispense chloroquine treatment. FTDs collect blood slides in addition to distributing drugs. Community Health Volunteers (CHV) are also multipurpose health workers at the most peripheral level, who receive training and support from the health service but no salary. Detection and treatment of fever cases is one of their duties.

The former phasing of areas ("maintenance," "consolidation," "attack") has been discontinued. Spray operations are based on the Annual Parasite Incidence (API). Under the MOP, peripheral officers can modify antimalarial operations in the field to suit particular requirements.
ACD/PCD

Multipurpose health workers carry out ACD at the peripheral level. Community Health Volunteers (CHVs) also collect blood slides of fever cases.

During the transition into integration (1978-82), ACD on a fortnightly or monthly cycle for blood slide collection from fever cases was conducted by Malaria Surveillance Workers who were appointed for the purpose (1 worker per 10-15,000 population, about 8-10 villages).(25) It is not clear whether these workers still exist, or now function as multipurpose workers.

PCD is carried by collection of blood slides of all fever cases in Government, Civil, and Cottage Hospitals, Zilla Parishad and Municipal Dispensaries, Government Primary Health Centers.(25)

Fever Treatment Depots (FTD) collect blood slides in addition to the distribution of drugs. These establishments are staffed by village volunteers. Drug Distribution Centers (DDCs) were established in villages to dispense chloroquine but do not collect blood slides. By 1983, over 360,000 village volunteers for malaria control were in place at FTDs and DDCs. In Gujarat, these volunteers are reported to be collecting 60% of the blood slides. No statistics on slide collections or fever cases treated by these sources were available for this report.

The NMEP-stipulated blood slide collection target (ABER) is not less than 10% of the population in district annually: 7.2% by ACD and 2.8% by PCD. Furthermore, during the active transmission season (June to October), the target is 1% per month.(25)

Method of Diagnosis and Coverage

Under the MOP, the centralized laboratory services at the NMEP unit headquarters were decentralized to the Primary Health Centers (PHCs) with three objectives: 1) to ensure prompt examination of slides by reducing delay in transit, 2) to provide clinical laboratory support to the medical officers in the PHCs, and 3) to provide laboratory facilities for other national health programs (tuberculosis, filariasis).(12)

Drug Protocols

Presumptive treatment (chloroquine 600mg) is given at the time of making a blood slide.(25) Drug Distribution Centers (DDCs), run by village volunteers, distribute chloroquine to fever cases without taking a blood slide.

Under the MOP, radical treatment for *P. falciparum* has been reduced from the former 5-day regimen to a single dose treatment (chloroquine 600mg; plus either pyrimethamine 50mg, or primaquine 50mg, for gametocytocidal/sporontocidal action). "The simplified schedule [a single dose] has enabled the completion of radical treatment of about 90 per cent of *P. falciparum* cases."(12) Radical treatment is believed efficacious, in spite of: enormous delays from collection of slides to diagnosis to treatment; the presence of many undetected cases; asymptomatic carriers.(12)

Single dose sulfadoxine-pyrimethamine (Fansidar, 2 tablets) or sulfalene-pyrimethamine (Metakelfin, 2 tablets), plus primaquine 45mg is used to treat chloroquine-resistant *P. falciparum* malaria.(25)

Quinine is used to treat cerebral malaria cases, either orally or by IV infusion.(25)
For microscopically confirmed *P. vivax*, radical treatment is the 5-day regimen (chloroquine 600 mg day 0, plus primaquine 15mg x5 days). Due to delayed examination of slides and lack of manpower, approximately 50 percent of patients receive only anti-relapse treatment.\(^{12}\)

Under the MOP, peripheral officers are given latitude to change tactics to suit particular situations. E.g., a 3-day regimen for radical treatment of *P. falciparum* was practised in Tamilnadu State [as of 1979] (chloroquine 600mg single dose, plus primaquine 25mg x3 days).\(^{12}\)

Mass drug administrations have been carried out in Mizoram, one-time operations and as supplements to spraying.

**Spray Operations (frequency/insecticides used)**

Indoor residual insecticide spraying is a major antimalarial activity. Approximately 300 million people are under spray operations. About 20-30 million are under malathion spray (mainly in Gujarat and western part of Maharashtra, parts of Haryana, and part of Rajasthan). Indoor residual spraying is only undertaken in rural or semi-urban areas.

In urban areas no regular spraying is carried out or envisaged. However, larviciding is carried out weekly by oiling (with "malariol") of temporary and permanent stagnant water collections.\(^{25}\) There have been extended trials of larviciding with temephos (Abate), and ULV fogging with malathion.\(^{23}\)

The former stratified phasing of areas ("maintenance," "consolidation," "attack") has been discontinued under the MOP. Spray operations are based on the Annual Parasite Incidence (API) determined in surveillance sections (generally at the rate of one worker per 10,000 population).\(^{12}\) API of 2 cases per 1000 population is the selection criterion for spray operations, though "vulnerable or receptive areas" are also included. This API determination cannot be timely, however, because of the huge backlog of undiagnosed blood films. Eradication of transmission is pursued in areas that respond well to spraying, even though the API drops below 2 permille.\(^{12}\)

DDT (1.0 g/m\(^2\), 2 cycles annually), HCH (0.2 g/m\(^2\), 3 cycles annually), or malathion (2.0 g/m\(^2\), 3 cycles annually) is used based on efficacy and results of susceptibility tests on the local vector.\(^{12}\)

Spraying is carried out during the regular malaria transmission season from June to October. The effectiveness of DDT is 8-10 weeks, and 6-8 weeks for HCH and malathion. The 2 or 3 spray cycles are timed according to this effective life.\(^{25}\)

Some States have used school children in spray operations, which coincide with the summer vacation of schools. Better public acceptance is reported.\(^{12}\)

**Type of Epidemiological and Entomological Data Available**

From the background of malaria eradication on the WHO model, the standard statistics of blood film collection and diagnosis are available. In recent years, a large backlog of undiagnosed blood films has been reported.

When the MOP was initiated, there were no entomological units in many of the States. Special entomological teams (72) have been established at the zonal level.\(^{12}\)
Training Programs (pre-service and in-service)

The National Institute of Communicable Diseases (NICD), New Delhi, is the national center for teaching and research in the epidemiology and control of communicable diseases. The NICD has a Division of Training and Malarialogy dealing specifically with malaria training. The malaria teaching faculty is composed of NICD and NMEP staff, who conduct 6-8 week malaria and entomology training courses for senior officers. There is a NICD Field Practice Unit, in Rajasthan, which is used in the general malarialogy course for all senior officers, to provide about ten days of practical experience. There are six regional branches of the NICD (Bangalore, Calicut, Coonoor, Patna, Rajahmundry, Varanasi) for training of Medical Officers of the Primary Health Centers (one week course).

Senior officers' training is conducted at the NICD, in collaboration with the NMEP.

Refresher and orientation training of officers and basic training of malaria inspectors and technicians (microscopists) is conducted at the Regional Offices for Health and Family Welfare and the State Training Centers.

There are several other institutions that contribute to the training potential: All India Institute of Hygiene and Public Health (Calcutta) provides postgraduate courses for a Diploma in Preventive Medicine and Public Health; School of Tropical Medicine (University of Calcutta) teaches a one year course leading to a Diploma in Tropical Medicine and Hygiene, which plays an important role in providing necessary postgraduate training to future malarialogists; Regional Training Centers, District Health Office-cum-Training Centers, and Primary Health Center-cum-Training Centers in the respective States are used for training of multipurpose health workers, who have replaced the former malaria surveillance workers.

Operations Research (in-house, universities, etc.)

In 1978, Rs. 20 million were earmarked for malaria research, but only one sixth of the amount was spent due to non-availability of suitable research manpower.

NICD is engaged in research on malaria. Most of the activity seems to be evaluation of pesticides and insecticide resistance of vectors, and field testing of antimalarial drugs to assess sensitivity or resistance.

The Vector Control Research Center (Pondicherry) and its field stations in Salem conduct studies on the biology and ecology of vectors and evaluation of various antivector methods, such as field trials of larviciding, ULV fogging, and other alternative antivector measures. There are also epidemiological studies carried out.

There is the Malaria Research Center (ICMR) in Delhi.

A large agenda of research is/has been carried out. The following is a summary of some the published work:

- Bioassay tests were conducted with malathion on different wall surfaces (mud, cement, wood) to test the effective life of the insecticide against An. culicifacies.

- Paris green (arsenious oxide) was evaluated in a field trial as a larvicide against anophelines in Maharashtra (species unnamed).
Paris green was evaluated as a larvicide in Maharashtra in 1978-79\(^{(27)}\) against An. culicifacies resistant to DDT, HCH, and malathion. Weekly application to breeding sites (slow meandering streams) from February to June; one cycle of malathion residual spraying in September-October (instead of 3 cycles per year); all wells in the project area were treated with temephos (Abate) fortnightly. Although problems of comparison (inadequate reference data), there was indication of vector reduction by the larviciding, though residual spraying was still essential in the peak transmission period. Paris green can be used as an economical substitute for temephos in some situations; larviciding can be used during part of the transmission season to reduce the number of essential residual spray cycles.

A study in Northern India (Rajasthan) revealed spring malaria transmission by An. stephensi\(^{(19)}\) in addition to An. culicifacies transmission during August-September. This is significant because the area is rural semi-desert (not urban), and An. stephensi is breeding in wells and maintaining transmission, while vector control strategy in region is aimed at An. culicifacies as a monsoon vector (three rounds of HCH spray from mid May to mid October).

Larvivorous fish have been successfully used to control breeding, but they do not thrive in all situations.\(^{(10)}\)

Urban malaria is transmitted by An. stephensi, which breeds in wells (larvicidal oils cannot be used). Effective dose of temephos was field-tested using a volume determination, rather than surface area, with recommendations for a survey system to monitor water levels in wells, so that effective dose of temephos can be maintained throughout the year, as water level in wells varies.\(^{(22)}\)

A paper from the ICMR proposed an ambitious project for the synthesis and release of genetic strains of An. culicifacies susceptible to insecticides.\(^{(18)}\) While feasibility is unclear, it does indicate imaginative thinking.

**ANALYSIS OF OPERATIONAL PROBLEMS**

**INSECTICIDE RESISTANCE**

Vector resistance is a major problem. DDT resistance in two principal vectors (An. culicifacies and An. stephensi) appeared in the late 1950s, HCH resistance appeared soon after its substitution, and malathion resistance has developed where used against An. culicifacies. Use of residual insecticide spray continues to be the major weapon of antimalaria intervention in rural areas. In urban areas where An. stephensi is the vector, larvicidal measures are used in place of residual spraying.
An. culicifacies has shown varying degree of DDT resistance in a number of states, starting with complete resistant to DDT in Maharashtra in 1967. HCH resistance appeared after only 3-4 spray cycles in already DDT resistant population. Malathion resistance then appeared after 13-15 cycles in 1973 in Maharashtra(23),(29), Gujarat(14). In Karnataka, testing during 1973-78 demonstrated wide resistance to DDT and HCH, but susceptibility to malathion, propoxur, and fenitrothion.(16)

An. stephensi has shown DDT and HCH resistance to a high degree in many states.

An. fluviatilis is still largely susceptible, though isolated reports of DDT resistance exist.

An. sundaicus(9) is still highly susceptible to DDT.

An. philippinensis(21),(20) and An. balabacensis(6) (northeastern India) still DDT susceptible due to exophily.

An. maculatus was found resistant to DDT in Arunachal Pradesh (far northeastern India).(21)

Principal vectors:
An. culicifacies main malaria vector
An. balabacensis northeastern India
An. philippinensis northeastern India
An. minimus northeastern India
An. sundaicus West Bengal and Andaman and Nicobar Island
An. fluviatilis coastal regions
An. stephensi some parts of Gujarat and urban towns
An. subpictus coastal regions of southeast India(11)

VECTOR BEHAVIOR
Vector bionomics and behavior are under study, but few results are available. Exophily in An. philippinensis in Burnhat area of Meghalaya State has been identified.(13)

SPRAY COVERAGE
Spray operations are not satisfactory both in time and in space due to insufficient training and interest of multipurpose health workers, and the greater stress placed on achieving family planning targets.

In 1979-80, the National Malaria Eradication Program was changed from 100% centrally-funded to a centrally-aided program in which the state and the center share costs on a 50:50 basis. When implemented, a number of states could not procure adequate and timely quantity of appropriate insecticides and could not support spray operations in all areas with API > 2. Adjustments re-focused on hard core areas. Still in 1983, there was a shortfall of insecticide due to lack of funding, and as a result many areas did not receive residual spraying.

In Maharashtra, one report(27) states 80-90% coverage is achieved, but repeated mud-plastering of walls after insecticidal spraying occurs.
DRUG RESISTANCE

Drug resistance is becoming a major problem. Chloroquine resistance was first detected in 1973 in Assam.\(^{(17)}\) In areas of chloroquine-resistant \(P. falciparum\), response to chloroquine varies from RI-RIII levels. Chloroquine resistance is confirmed (in various degrees) in the following areas:

northeastern India (Assam, Arunachal, Meghalaya, Mizoram, Nagaland, Manipur, Tripura)\(^{(7)}\)

two districts of West Bengal, Orissa state, part of Maharashtra (Chandrapur District),\(^{(3)}\) Gujarat, Uttar Pradesh (Mizapur and Mathura District)

Pyrimethamine resistance has been detected in Assam and Andhra Pradesh.\(^{(2)}\) Pyrimethamine has always been used in combination with 4-aminoquinolines by the NMEP, but it is freely available from medical practitioners.

The following second line drugs are used in areas of chloroquine resistance:

- Metakelfin (sulphalene 500mg and pyrimethamine 25mg)
- Fansidar (sulphadoxine 500mg and pyrimethamine 25mg)
- quinine sulphate
- Mefloquine

QUALITY OF DIAGNOSTIC WORK

The collection of blood slides is not uniform during the year, showing a peak during the transmission season. Backlogs build up which are not examined until many months after collection. The positives detected are counted in the appropriate month's statistics, but obviously the delayed examination precludes timely administration of radical treatment. About 2 million blood slides remained unexamined during the year 1978, and also during 1979.\(^{(12)}\)

Due to delayed examination of slides, as well as lack of manpower, approximately 50 percent of patients are given only anti-relapse treatment.\(^{(12)}\)

QUALITY OF ENTOMOLOGICAL DATA

There is a great deal of entomological research occurring which is listed in some detail in the Operations Research section above. There are many researchers, and the quality is variable from very good to mediocre.

QUALITY OF EPIDEMIOLOGICAL DATA

Variable throughout the country. There is a great need to get data analysis under control of a management information system. Otherwise it is hard to see how an epidemiologically responsive control approach can be implemented.

QUALITY OF TRAINING PROGRAMS

Variable throughout the country.

OTHER PROBLEMS

Although the volunteer workers (FTDs and CHVs) are credited with collecting large numbers of slides in Maharashtra,\(^{(24)}\) other reports state that the multipurpose workers program resulted in malaria surveillance receiving less attention in southeast India.\(^{(2)}\)
PROGRAM FINANCING

The planned expenditure on NMEP in 1979-80 was Rs. 735 million (7350 lakhs), which is equally shared by the Government of India and the State Governments. The State Governments spend an additional Rs. 82.1 million (821 lakhs) annually. With 50% of the Central funding turned over to the State Governments, they have partial responsibility for procurement of material and equipment and operational costs.

When the 50%-50% arrangement was implemented in 1979-80, many State Governments could not support spray operations in all areas with API > 2. Adjustments refocused on hard core areas. Still in 1983, there was a shortfall of insecticide due to lack of funding, and many areas did not receive residual spraying.

The Sixth Five-Year Plan (1980-85) planned Rs. 400 crores ($440 million) for malaria control in the Communicable Diseases Control budget, which is 76% of the CDC budget. Malaria control expenditures represent 21.9% of the total health budget.

The Swedish International Development Agency (SIDA) has provided approximately $16.0 million assistance from 1978-83 for the Plasmodium falciparum Containment Program (PfCP). This program concentrates on North East India, West Bengal, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh, and the Western part of India. An additional funding of $10.0 million from SIDA will be available to PfCP in 1983-88. (See Table 4-2.)

STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

The country visit report of the Joint WHO/USAID Task Force on the Malaria Training Programme for Asia cites NICD experts conducting training activities, who pointed out the need to organize an exchange of experience with experts from other training institutions with mutual fields of interest (malaria, parasitology, entomology, tropical medicine). It was thought WHO, possibly cooperating with USAID, could organize consultations of participants from developed and developing countries to improve teaching methodology.

Similarly, consultations and fellowships to improve the knowledge and skills needed for specific areas of research were listed (e.g., seroimmunological diagnosis of malaria, cytogenetic and other vector species diagnostic methods).

The NICD urgently needs to improve its documentation and data processing services. Timely statistics are essential to a flexible, reactive antimalaria program, as is implied by an integrated malaria control program which does not follow a time-limited eradication strategy. The blood film backlog must be solved.
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<td>USAID loan</td>
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<td>WHO</td>
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<td>$2,800,000²</td>
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<td>SIDA (Swedish aid)</td>
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<td>$320,000</td>
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<td>(78-83 $1,600,000)</td>
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<td><strong>Total</strong></td>
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<td>$122,050,000</td>
<td>$133,020,000</td>
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In U.S. dollars.

Source:
2 USAID (1984), cable from AID/New Delhi mission.
3 Pattanayak S and Roy RG (1980), Malaria in India and the modified plan of operations for its control, J Com Dis 12(1):1014.
4 for Insecticides, larvicides, and ULV foggers.
POTENTIAL NEEDS FOR AID ASSISTANCE

The USAID Integrated Rural Health and Population Project is a broad based health assistance activity designed to assist the GOI in developing health and family welfare services in rural India. USAID funds for the 1981-85 period are projected to total $40.0 million of which $2.0 million are meant for innovative operational activities. A proposal for operational research on malaria control under this project has been formulated.(1)

Support operational research with NMEP and Pondicherry research center:
- computerization of data collection and analysis
- alternative larvicides and insecticides
- community malaria control schemes at the PHC level, especially in conjunction with the AID Integrated Rural Health project

Technical assistance
- support for research, development, and evaluation of rapid serological diagnostic tests
- support for research, development, and evaluation of rapid entomological tests based on immunology (e.g., ELISA/RIA diagnosis of sporozoites)
- possible support for malaria vaccine trial - survey and selection of appropriate trial sites, collection of baseline data
- teaching methodologies and design of training programs

Vector control
- insecticiding with ULV equipment, especially when appropriate (e.g., urban epidemics)
- alternative anti-larval measures - predators, BTI

Training
- sponsor inter-country visits - CDC, NIH, mosquito abatement districts, Kuala Lumpur Secretariat
- support to NICD for training in malaria
BIBLIOGRAPHY - INDIA


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Indonesia is a vast country, much of it water, consisting of 13,600 islands in an archipelago stretching over 3,000 miles. The large population (147.5 million, 1980 census) is unevenly spread through the islands. Java and Bali (6.9% of the land area) contain 63.6% of the population (93.7 million). The remainder of the country, termed the Outer Islands (93.1% of the land area), is inhabited by the other 36.4% of the population (53.7 million). Even in densely populated Java and Bali islands, the majority of the population lives in rural communities (about 20,000 villages in Java and Bali).(1),(19)

The large population and vast areas represent fundamental constraints to effective antimalaria activities. Multiplying the problem is the extent and enormity of population mobility due to transmigration (a government-sponsored program), spontaneous land settlement, trade and commerce, lumbering, plantations, and other industrial establishments, construction and development projects.(15)

The integrated Malaria Control Programme (MCP) provides antimalaria protection to most areas of Java and Bali, according to availability of resources and the existing local situation. with emphasis on foci of high incidence. In the Outer Islands, antimalaria activities are targeted/limited to areas of transmigration and economic development, and also to control of malaria outbreaks.(15) These antimalaria activities in priority areas of the Outer Islands actually cover only about 3 million people.(1)

The transmission of malaria is quite different between Java and Bali, and the Outer Islands. Sixteen different vector species are confirmed from the various islands of Indonesia. In Java and Bali, the main malaria vectors are An. aconitus in rice-growing areas (breeding in paddy fields), and An. sundal­cus in coastal areas in the south (breeding in brackish water). The secondary vectors are An. maculatus in hilly areas, and An. subpictus in the coastal areas. By contrast, the principal vector in Kalimantan (Indonesian Borneo) is An. balabacensis, a forest, freshwater breeder. In Irian Jaya, the principal vectors are An. farauti, which breeds in coastal swampy water subject to tidal fluctuations, while An. koliensis and An. punctulatus breed in a variety of peridomestic standing water pools, ditches, natural water pools, as well as forest sites.

HISTORY OF ANTIMALARIA ACTIVITY

Antimalaria units performing larviciding and sanitary engineering measures were functioning in 1919. Field trials of indoor residual DDT spraying were conducted in 1947-48. A limited program of indoor residual spraying began in 1950 and expanded into a malaria control program during the early 1950s, under joint sponsorship of the Government of Indonesia, WHO, and USICA. By 1958, a population of 17-18 million was under insecticide protection.(2)

A National Malaria Eradication Service was established in 1959, concentrat ing on Java-Bali, with planned expansion to the Outer Islands as a later stage. Dramatic reduction of malaria in Java-Bali was recorded until 1965, when severe political instability occurred in Indonesia, combined with worsen-
ing economic conditions due to cessation of bilateral assistance. The eradication program (then called the National Malaria Eradication Operation Command) was disrupted due to financial and administrative difficulties. Without a definite anti-malaria campaign, DDT consumption declined from 3,626 tons in 1964 to 0.7 ton in 1968; in other words the operational program was virtually defunct. The SPR increased from 0.04% in 1965 to 0.44% in 1968.\(^\text{3}\)

The Malaria Operation Command was reorganized and integrated within the Directorate-General for Communicable Diseases Control (as a Sub-Directorate within the Directorate of Vector Borne Diseases Control). The provincial and peripheral malaria organization was reorganized as integrated malaria control programs (IMCP) with a decentralized responsibility for implementation at the Regency level.\(^\text{3}\) The new anti-malaria campaign was begun in Java and Bali, based on focal spraying and treatment of cases,\(^\text{19}\) but the lack of direct vertical control and coordination of antimalaria activities was apparently deleterious.

"Thereby, the programme was reduced to a mere fire-fighting operation which resulted in a four-fold increase in case incidence by 1968. Between 1968 and 1973, the case incidence recorded a 15-fold increase."\(^\text{2}\)

During the Second Five-Year Development Plan (Pelita II: 1974-79), commodity support from USAID and budget support from the Government of Indonesia transformed the effort into a control program that reported a 54% reduction of case incidence in Java-Bali (1974 to 1978).

DDT consumption increased from 45 tons in 1969 to 1,390 tons in 1978. SPR remained at a 2-3% level, but this was due to high and increasing SPRs in Regency Banjarnegara and Regency Wonosobo, while most regencies showed declines. (During 1976-78, nearly 50% of total malaria positive slides in Central Java were from Regency Banjarnegara.)\(^\text{3}\)

The Third Five-Year Development Plan (Pelita III: 1979-84) has sought to maintain the antimalaria efforts of Pelita II in Java-Bali and to expand to the Outer Islands. USAID is funding a five-year project to extend malaria control operations to Timor Island. USAID is also funding a village-based malaria control project in Flores, as part of the CHIPS project. The World Bank is supporting a health project in Sulawesi, with a substantial malaria control component (and two malaria advisors).

SCOPE OF MALARIA PROBLEM SINCE 1975
Malaria Mobility and Mortality

Malaria is a major health problem in Indonesia. Over 100,000 cases are confirmed annually in Java-Bali, but it is estimated that the true incidence is 1 million cases annually.\(^\text{14}\) In Irian Jaya, malaria is one of the highest cause of mortality, both hospital and non-hospital (e.g., in Jayapura Hospital, neonatal deaths are highest, while malaria is second causing 15% of mortality).
Table 5-1: No. of Malaria Cases Recorded
No. of Blood Films Examined
Slide Positivity Rate (SPR)

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<tbody>
<tr>
<td>Total Positives</td>
<td>125,166</td>
<td>96,999</td>
<td>110,553</td>
<td>127,590</td>
<td>78,854</td>
<td>176,733</td>
<td>124,656</td>
<td>84,266</td>
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<tr>
<td>No. Blood Films</td>
<td>8,208,897</td>
<td>7,859,677</td>
<td>8,084,880</td>
<td>8,174,431</td>
<td>8,042,198</td>
<td>9,085,040</td>
<td>9,128,856</td>
<td>9,196,556</td>
<td>-</td>
</tr>
<tr>
<td>SPR</td>
<td>1.5%</td>
<td>1.23%</td>
<td>1.37%</td>
<td>1.56%</td>
<td>0.98%</td>
<td>1.93%</td>
<td>1.37%</td>
<td>0.92%</td>
<td>-</td>
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<tr>
<td>API (permille)</td>
<td>1.4%</td>
<td>1.11</td>
<td>1.23</td>
<td>1.39</td>
<td>0.84</td>
<td>1.85</td>
<td>1.30</td>
<td>0.86</td>
<td>-</td>
</tr>
<tr>
<td>ABER (slides/100 pop)</td>
<td>9.53</td>
<td>9.96</td>
<td>9.03</td>
<td>9.81</td>
<td>8.61</td>
<td>9.35</td>
<td>9.54</td>
<td>9.42</td>
<td>-</td>
</tr>
<tr>
<td>XP.f.</td>
<td>35.28%</td>
<td>40.84%</td>
<td>39.60%</td>
<td>34.39%</td>
<td>46.95%</td>
<td>46.6%</td>
<td>45.2%</td>
<td>54.3%</td>
<td>-</td>
</tr>
<tr>
<td>No. of P.f.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No. of P.V.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Population (million)</td>
<td>86.1</td>
<td>87.7</td>
<td>89.6</td>
<td>91.5</td>
<td>93.4</td>
<td>95.4</td>
<td>95.6</td>
<td>97.6</td>
<td>-</td>
</tr>
</tbody>
</table>


| Total Clinical Cases | - | - | - | - | 1,075,658 | 1,241,403 | 756,771 | 1,214,496 | -     |
| Total Positives | 89,180 | 80,294 | 56,390 | 60,270 | 87,105 | 130,279 | 90,730 | 105,121 | -     |
| No. Blood Films | - | - | - | - | 360,428 | 488,616 | 353,788 | 411,758 | -     |
| SPR       | - | - | - | - | 24.3% | 26.7% | 25.6% | 25.5% | -     |
| XP.f.     | 16.5% | 19.9% | 28.5% | 34.5% | 31.9% | 35.5% | 40.4% | 31.8% | -     |
| No. of P.f. | - | - | - | - | 27,778 | 46,309 | 36,616 | 33,386 | -     |
| No. of P.V. | - | - | - | - | - | - | - | - | -     |


1 This table is a composite of data from the above two sources, which seem to be in complete accord where their data overlap. The data is comprised of statistics accumulated from the various PCD sources, such as hospitals, Health Centers, polyclinics, and MCH centers (353 health centers in the Outer Islands).
Figure 4-1.

SLIDE POSITIVITY RATE 1980

Fig. 3—Map of Java showing slide positivity rate in 1980.

Fig. 4—Areas of Indonesia with persistent malaria transmission, predominant incidence of Plasmodium falciparum (Pf) and locations of confirmed Pf resistance to 4-amino-quinolines.

Several malariometric surveys have been conducted in the Outer Islands:

**FLORES**
Lee et al. (1983)(21) in Flores island found in the young and adult population a high prevalence of parasites and splenomegaly (hologendemic). (Splenomegaly: 2-9 yrs-95%; 10 yrs and older-96%) (Parasite rate: 2-9 yrs-77%; 10 yrs and older-20%) Three species were present, P.f., P.v., P.m. The principal vector was An. subpictus (78% of all anophelines captured; sporozoite rate=0.36%); secondary vector An. barbirostris (sporozoite rate=4.54%). Low vector densities were recorded during July to October; high densities during December to March. Both species are highly anthropophilic due to scarcity of large animals (no cattle, few buffalo and goats) in Flores.

**CENTRAL SULAWESI**
Stafford et al. (1980)(31) in a Central Sulawesi valley found a parasite rate of 6% (all age groups, P.f. and P.v.). Malaria was most prevalent in the 0-9 yr. age group. Splenomegaly rate was 54% (36% in 2-9 yr age group).

**IRIAN JAYA**
Lee et al. (1980) in Irian Jaya reported splenomegaly ranging from 78-97% in 2-9 yrs age group, and parasite prevalence of 21-52% (hologendemicity). P.f. was greatly predominant. An. koliensis and An. punctulatus were incriminated by sporozoite isolation. An. farauti is another well established vector. Two of 3 investigators on this study contracted P. falciparum although on chloroquine prophylaxis. The vector populations exploit human-created breeding sites.(22)

**REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM**
**HIGHLIGHT NOTABLE DEPARTURES FROM TRADITIONAL STRATEGIES**
In February 1982, a containment measure was initiated in a chloroquine-resistant falciparum focus of Jepara, Central Java (an area of 95,000 houses and 415,000 population). Additional personnel were made available to intensify case detection and treatment activities as well as to improve the quality of DDT indoor residual spraying. All confirmed Pf cases were treated with single dose of Fansidar plus primaquine.(15) Larvivorous fish (the tin head - kepala timah) are used for control of brackish water breeding vectors in some localities, but no detailed information is available.(34)

Community participation in malaria control activities is envisaged through the Village Community Health Development (PKMD) program. This is a voluntary organization working in cooperation with the Village Community Resilience Committee (LKMD) which is under the Ministry of Interior.(1) PKMD has been implemented in only a few villages in each regency. It is planned to have an organization committee of about 15-25 members and about 50-100 Health Volunteers (Prokesa) in each village. The Prokesa would function as a paramedic providing medication and medical advice, including the collection of blood slides and provision of presumptive treatment. Diagnosis of blood slides, support, and supplies will come from the nearest health center.
Community participation in other antimalarial activities, such as source reduction where appropriate, collaboration with spraying operations, monitoring of population from malarious to non-malarious areas and for fever, will be implemented under the social custom of "gotong royong" (cooperative helpfulness). This program is still in the early stages of implementation, so evaluation is not yet possible.

The AID CHIPS project and the World Bank health project in Sulawesi are also funding community-based malaria control activities.

BRIEF DESCRIPTION OF DELIVERY SYSTEM NOW IN USE

Structure and Staffing

The Malaria Control Program is decentralized and integrated into the system of general health services. At the national level, there is a Sub-Directorate of Malaria under the Directorate of Vector Borne Disease Control which in turn is under the Directorate General of Communicable Disease Control (CDC) in the Ministry of Health (MOH). However, antimalarial activities are planned, implemented and evaluated at the provincial/peripheral levels. The role of the Sub-Directorate of Malaria is to coordinate country-wide planning, provide technical guidance and operational support, assist in evaluating progress, assist in training of local staff and higher echelon staff, and assist in carrying out applied field research. Entomology and parasitology are separate services. Malaria information is supposed to be the responsibility of the Directorate of Epidemiological Surveillance, though all useful malaria data still come from the Malaria Subdirec torate.

"In view of the autonomy of the provincial and peripheral administrative structures of the Ministry of Interior, the role of the MOH and thus the role of the Directorate-General, CDC, has been primarily that of provision of technical guidance and assistance and inter-departmental, inter-sectoral and multi-lateral coordination. It has no directional or controlling authority over the province or the periphery."(1)

At the provincial level, the administrative structure of the Ministry of Interior has highest authority. There is a parallel system of health establishments: the Provincial Health Services Organization (Dinas Kesehatan Propinsi), which is a component of the autonomous provincial administration (headed by the Governor) and responsible for the implementation of health care services; and the Health Office of the MOH (Kantor Wilayah KEKES), which has the role of liaising between the MOH and the provincial administration, attempting to enhance the technical capabilities and support the proficiency of implementation of the peripheral health programs and services, but with only a very limited role in the delivery of any services.

At the peripheral level (Regency/Kabupaten) the integrated health organization is led by the Chief Medical Officer (DOKABU). At this regency level, multipurpose health service staff carry out anti-malarial activities: geographical reconnaissance, spraying operations, logistics for the field activities, and blood slide examination. Relevant staff from the Sub-district level health centers assist and cooperate in carrying out malariometric surveys and spraying operations in the field. In all these activities, the respective malaria and CDC sections assist and liaise, but do not have ultimate responsibility. They play a largely advisory role of lesser impact.(2)
Figure 5-2.
Position of Malaria Control Program
within Indonesian Administrative Structure
Although the provincial health service is an autonomous department under the Provincial authority, logistic support for antimalaria activities comes mainly from MCP/HQ. DDT, spraycans, and microscopes are purchased and supplied by the central malaria office to the provinces according to need and requisition. Drugs are purchased by the central office and by the provincial offices. All other supplies are procured locally, except that Giemsa stain, buffer tablets, and anisol are provided by HQ MCP/CDC. It appears that when this system was implemented during the late 1960s, there was confusion, lack of control and coordination, resulting in ineffective action for several years. However, it now appears that time, and budget support, has stabilized the definition of duties and responsibilities, so that the malaria program in Java and Bali has shown progress.

ACD/PCD

Most malaria is diagnosed through PCD in hospitals and health clinics. The health institutions are fairly well established in Java-Bali. In the Outer Islands, every sub-district (kecamatan) within a regency has at least one health center. Most also have sub-centers and polyclinics. All health institutions diagnose clinical malaria cases. Where laboratory facilities exist, blood slides are collected and examined of fever/clinical malaria cases.

Monthly ACD activities in Java-Bali are undertaken depending on the availability of field staff at the health centers, i.e., variably in time, space, and quality. Malarriometric surveys ("sample surveys" or "mass fever surveys") are sometimes carried out. Mass surveys are done when focal outbreaks seem to occur. Epidemiological investigations and follow-up are carried out depending on supervisory staff.

In the Outer Islands, ACD is not carried out even in priority areas (of transmigration or economic development). Malarriometric surveys (spleen surveys of 2-9 yr olds, and parasite surveys of infants and 2-9 yr olds) are carried out depending on availability of staff. These are carried out before and after spraying operations in the priority areas with the intention of assessing endemicity and impact of spraying. However, it is reported that sampling is commonly inadequate and noncomparable in these surveys.

Method of Diagnosis and Coverage

In Java and Bali, there is an extensive system of health centers and hospitals with laboratories. In these facilities, large numbers of blood slides are examined.

In the Outer Islands, there is less complete extension of health institutions, though every sub-district (kecamatan) within the regencies has at least one health center. The principal emphasis is on areas of economic development. Thus the coverage is only partial. In the Outer Islands, the majority of malaria cases are clinically diagnosed, due to general lack of laboratory services and trained microscopists. Only about 10% of the reported malaria cases are blood slide confirmed.

Drug Protocols

Suppressive treatment is given to clinically diagnosed malaria cases (in health institutions and in the course of malarriometric surveys). This is a single dose of chloroquine (adult: 600 mg). In areas of chloroquine-resistant P. falciparum, 45 mg of primaquine is also given, as a gametocytocidal. This single dose of chloroquine plus primaquine is also administered as mass chemo-
cal and seasonal distribution of vectors, vector bionomics, impact studies, delineation of vector resistance to insecticides, studies in problem areas utilizing the parameters of vectorial capacity and investigation of areas of continuing transmission. In the Outer Islands, identification of primary and secondary vectors in the priority operational areas and investigations relating to malaria transmission will form the basis of entomological activities. (2)

Training Programs (pre-service and in-service)

There is a Directorate for Health Education and Training still in its developmental stages. There is no established malaria training section or curriculum within the CDC. Malaria training is undertaken drawing from the existing health/CDC/malaria staff, supported by WHO staff, who do this as an additional ad hoc duty. Plans for expanded training facilities and courses exist, but have not yet been implemented. (36)

The limited central level training is directed to developing health staff of the provinces, regencies and sub-districts: medical officers, senior supervisors, entomologists, senior laboratory technicians, and others. Junior staff are trained at the provincial level, and field staff at the regency and sub-district levels. All of these activities are described as far below requirements, both in length of course and in number of participants.

<table>
<thead>
<tr>
<th>Table 5-2. Number of Staff Trained in Malaria Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>Local professionals (doctors, entomologists, sanitarians)</td>
</tr>
<tr>
<td>Local technicians (malaria chiefs, microscopists)</td>
</tr>
<tr>
<td>Local temporary workers (spray squad chiefs, spraymen, surveillance agents)</td>
</tr>
</tbody>
</table>

therapy to all inhabitants in areas of epidemic outbreak.

Radical treatment is given to confirmed malaria cases in areas of no transmission or where reinfection is unlikely. *P. f.*, *P.v.*, and *P.m.* infections are all treated with 1500 mg of chloroquine divided over three days. *P.f.* cases are also given 15 mg of primaquine daily for three days; *P.v.* and *P.m.* cases are given 15 mg of primaquine daily for five days. For laboratory-confirmed cases of *P.f.* from areas of chloroquine-resistance, two alternative treatment regimens are used: single dose of Fansidar (3 tablets - 1500 mg sulfadoxine and 75 mg pyrimethamine) plus a single dose of primaquine (45 mg); or quinine (450 mg, twice daily for seven days) plus a single dose of primaquine (45 mg).

Spray Operations (frequency/insecticides used)

In Java-Bali, two annual cycles of DDT indoor residual spraying in areas of *An. aconitus* transmission. Dosage of DDT is varied according to susceptibility of the vector (1g/m² or 2g/m²). In areas of *An. sundaicus* transmission, a single cycle of DDT (2g/m²) is sprayed where the vector is still susceptible to DDT.

In the Outer Islands, the priority areas are covered by two annual cycles of DDT (2g/m²). This covers about 3 million of the 56.9 million population in the Outer Islands (1.16 million in 316 transmigration localities, and the rest in other priority areas - due to economic importance). Spraying operations are carried out in and around priority areas (to a perimeter of two kilometers). The cycles are timed to the local occurrence of clinically diagnosed malaria cases in the local health centers.

The malaria seasons are less clearly defined in most of the malaria-prevalent areas of Central Java. Larval densities are highest a few weeks before rice harvest time, but *An. aconitus* occurs throughout the year in most areas of Java. Transmission continues to occur without seasonal interruption during months of lower rainfall. Under improved irrigation facilities, the rice transplanting season is irregular, leading to extended availability of breeding sites. There is, however, a correlation between increased rainfall and increasing SPRs, and between mean number of rainy days and SPR.

So although seasonal abundance of the malaria vector varies from locality to locality, there is a main peak usually occurring in the early months of the year. In most of the terraced rice growing areas there are two seasonal peaks, the first in Feb-Mar and the second in Aug-Sep. Therefore, the spraying cycles are scheduled with the first in late January-early February, and the second in July-August. The duration of each cycle is usually longer than 2 months. There are unscheduled delays due to refusal of spraying.

Due to DDT resistance in areas of Java, malathion has been substituted. There have been trials of several alternative insecticides conducted.

Type of Epidemiological and Entomological Data Available

PCD data is available from the various health service institutions. Malarialometric surveys are carried out to monitor prevalence in selected areas. These data are collected and reported through the integrated epidemiological reporting of the general health services.

Entomological activities in Java-Bali include determination of geographi-
Operations Research (in-house, universities, etc.)

Although one function of the national level staff in the Sub-Directorate for Malaria is to assist in applied research, it appears that the small staff has limited ability to do so. Nonetheless, there is malaria research being carried out by other entities in Indonesia in collaboration with the Malaria Control Program. These are the WHO Vector Biology and Control Research Unit, and the U.S. Naval Medical Research Unit (NAMRU).

Research proposals have been submitted to the WHO that would fund projects by the University of Indonesia, Dept. of Parasitology.

Entomological activities are carried out by the Entomology Sub-Directorate. These include determination of anopheline fauna and their seasonal distribution, identification of vectors, monitoring of insecticide susceptibilities, evaluation of impact of DDT residual house spraying, and investigations of vector bionomics. Field research is carried out in collaboration with the WHO/VBCRU, NIHR&D, the Universities and the Malaria Sub-Directorate.(1)

ANALYSIS OF OPERATIONAL PROBLEMS
INSECTICIDE RESISTANCE

Insecticide resistance is a major problem in Java, where An. aconitus is resistant to DDT and dieldrin, a minor problem in the Outer Islands, where some vectors are showing reduced susceptibility to DDT.

An. sundaicus was first shown resistant to DDT in 1954. Dieldrin was substituted. An. aconitus was first shown resistant to DDT in Central Java in 1962, after 6 cycles of DDT spraying, and three years after dieldrin resistance was detected in 1959. The species is now DDT-resistant over wide areas of central and eastern Java. The use of pesticides in the rice fields probably resulted in intensive selection for insecticide resistance in An. aconitus.

Limited susceptibility tests have been carried out in the Outer Islands. Thusfar, malaria vectors have been susceptible to DDT in the one hour 4.0% DDT test exposure. Several vectors in various localities have not been tested since the mid-1970s. A few survivors have been observed recently with An. sundaicus in Lampung, An. barbirostris in Sulawesi, and An. koliiensis in Irian Java. These observations require confirmation.

Field trials of alternate residual insecticides and new application methods have been carried out in recent years (by WHO Vector Biology and Control Research Unit (VBCRU), in collaboration with the Ministry of Health and with financial support from USAID). From 1976 to 1980, 12 village trials of five residual insecticides in different formulation and dosage were tested in a group of villages near Semarang, Central Java (fenitrothion, malathion, pirimiphos-methyl, chlorphoxim, decamethrin).

Fenitrothion and pirimiphos-methyl reduced nocturnal landing and diurnal resting populations of An. aconitus; they also gave high contact and air-borne bioassays mortalities. Malathion(10) and chlorphoxim(9) had a limited impact on man-vector contact; they gave high contact bioassay mortalities, but no air-borne effect.
Fenitrothion was the most effective residual insecticide tested, but it is costly and toxic. Further trials were conducted with a reduced dosage (1 g/m² instead of 2 g/m²) which reduced the residual effectiveness from 3 months to 2 months. ULV applications of fenitrothion were tested at village-scale using backpack machines (Fontan R12). Vector populations were suppressed during the applications and for 2 weeks after the last cycle, but this measure is only suitable for epidemic situations due to short effect, equipment costs and intensive supervision required.

Another trial with fenitrothion is aimed at reducing operational costs by targeting cattle shelters (kandang) in which vector mosquitoes rest and feed on cattle. This is based on the feeding preference of An. aconitus for cattle. This "kandang selective treatment" may be suitable for implementation by the community with minimum technical guidance from health authorities.

Also exploiting this feeding preference is the use of zooprophylaxis by increasing the number of cattle in transmission areas. There is some scanty evidence to suggest that larger cattle populations correlate with lower SPRs, but this requires much better research data to prove that man-vector contact and malaria transmission are reduced. A Government of Indonesia development program distributes cattle in rural communities, which should be monitored for any effect on malaria transmission, as well as its primary purpose of improved nutrition and paddy cultivation.

VECTOR BEHAVIOR

An. aconitus has long been known to be primarily zoophilic, exophagic, and exophilic. Nonetheless, in many parts of Central Java, indoor spraying with DDT appears to have reduced malaria transmission in spite of vector resistance, but not in other areas.

In the past, transmission by An. sundalicus was prevalent in coastal areas, and countered with DDT spraying. However, since about 1965, An. sundalicus has disappeared from the entire north coast of Java, and is now responsible for only limited transmission in a few foci in the south coast of Central Java.

SPRAY COVERAGE

Refusal of spraying by home owners is a major problem. This occurs both as active refusal, and passive refusal (i.e., the homeowner washes his walls after the spray team departs). This has been documented by Marbaniati (1979).

DRUG RESISTANCE

Drug resistance is a moderate to major problem, depending upon the locality. In some localities chloroquine resistance at the RIII level has been detected, and Fansidar resistance has been reported.

A report exists from 1936 of poor response of P. falciparum to standard doses of quinine in East Kalimantan. Poor response to proguanil, after mass prophylactic treatment in West Java, was reported in 1951 (van Goor, Loden, et al., 1950, 1951), and to pyrimethamine, after mass treatment in Irian Jaya, in 1961 (Meuwissen, 1961).
Foci of chloroquine resistant *P. falciparum* were identified from 1973-1976 in East Kalimantan and Irian Jaya, using the in-vivo technique (RI and RII). Further testing from 1980-82, in-vivo and in-vitro, has confirmed chloroquine resistance in South Sumatra, Lampang, DKI Jakarta, West Java, Central Java, East Java, Bali, East Nusa Tenggara, East Timor, North Sulawesi, Central, Sulawesi, Southeast Sulawesi, South Sulawesi, West Nusa Tenggara. In Irian Jaya, resistance has shifted from RI to RIII, and in Central Java from RI to RII.

Fansidar resistance at RI level is reported from Irian Jaya in 1979, at RII level from East Timor in 1980. One in vitro test has been reported in 1982 of low sensitivity to mefloquine in Central Java (though mefloquine has not yet been used).

**QUALITY OF DIAGNOSTIC WORK**
Checking of slides is carried out.
There is a lack of laboratory facilities in Outer Islands, so that only a small percentage of the suspected cases are microscopically confirmed

**QUALITY OF ENTOMOLOGICAL DATA**
Entomological data seems to be good.

**QUALITY OF EPIDEMIOLOGICAL DATA**
Epidemiological data is supposed to be reported through the Directorate of Epidemiological Surveillance. Excessive delay in reporting from the peripheral districts to the province/central office due to the lack of implementation of the new recording and reporting system is reported.(1)
### Table 5-3.
Population Protected by Residual Insecticide Spraying

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</thead>
<tbody>
<tr>
<td>Java-Bali&lt;sup&gt;1&lt;/sup&gt;</td>
<td>5,710,000</td>
<td>10,476,945</td>
<td>14,858,255</td>
<td>13,269,185</td>
<td>13,422,895</td>
<td>-</td>
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<tr>
<td>Java-Bali&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>8,520,111</td>
<td>6,572,493</td>
<td>6,485,562</td>
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<td>Outer Islands&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1,491,118</td>
<td>1,474,380</td>
<td>1,883,178</td>
<td>2,149,533</td>
<td>2,729,575</td>
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<td>-</td>
</tr>
<tr>
<td>Outer Islands&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<td>2,348,730</td>
<td>2,617,360</td>
<td>3,013,968</td>
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</table>

**Sources:**

### Table 5-4.
Houses Sprayed in the Outer Islands

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<tbody>
<tr>
<td>Outer Islands</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>939,892</td>
<td>1,111,976</td>
<td>1,282,828</td>
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**Source:**
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<td>Host Government (US$)</td>
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<td>6,077,460</td>
<td>6,661,580</td>
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<td>10,438,990</td>
<td>8,627,750</td>
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<td>(Rp.000 million)</td>
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<td>-</td>
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<td>(Rp6.392)</td>
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<td>WHO</td>
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<td>$533,400</td>
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<td>(5 yr. loan, Java/Bali/Holida)</td>
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<td>$3,600,000 (81-86)</td>
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<td>(5 yr. loan, Timor project 81/82-86/87)</td>
<td>$3,600,000 (81-86)</td>
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<td>World Bank</td>
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<td></td>
<td></td>
<td>$5,000,000</td>
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<tr>
<td>(loan, Sulawesi)</td>
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<td>(loan, Sulawesi)</td>
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<td>1977/78</td>
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<tr>
<td>1978/79</td>
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<td>1979/80</td>
<td></td>
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<tr>
<td>1980/81</td>
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<tr>
<td>1981/82</td>
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<td>1982/83</td>
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<td>1983/84</td>
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</table>

QUALITY OF TRAINING PROGRAMS

There is a Ministry of Health training center which was once a malaria training center, but it no longer has a faculty. There are plans to develop four regional training centers and malaria curricula. There is a three-week training course given to a few senior staff each year, a course that is organized by Malaria Sub-Directorate staff. Several thousand junior staff are trained each year (spray squad chiefs, spraymen, and surveillance workers), but there does not appear to be a standard training curriculum for these sessions.

OTHER PROBLEMS

PROGRAM FINANCING

During the past 5 years (as of 1982), the national anti-malaria program took about 10% of the total national health budget. (2),(3) (See Table 5-5.)

STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

Anti-malarial activities are still minimal to modest in the Outer Islands, while incidence and transmission are high. The ability of the GOI to implement increased measures is limited.

There is a shortage of laboratory facilities and trained microscopists in the Outer Islands for diagnosis of malaria slides.

POTENTIAL NEEDS FOR AID ASSISTANCE

AID is supporting a malaria control project in Timor Island. This could be the model for other AID support and assistance for development of the anti-malarial effort in the Outer Islands. AID is also supporting the CHIPS project, including community-based malaria control.

Training
- in the Outer Islands
- training for senior staff at Malaria HQ and provinces.

Operational research
- support for baseline entomological and parasitological studies.

Community development/involvement

Commodity input

Technical assistance
- long term advisor
- short term technical group
  operational vector control
  entomology
- management of supplies, logistics, transport

Evaluation and analysis
BIBLIOGRAPHY - INDONESIA


23. Marbanati (1979), Primary health care in Banjarnegara, Java by village health workers with special reference to malaria, dissertation submitted for Diploma in Community Health of the Tropics, University of London, London School of Hygiene and Tropical Medicine.


33. Supratman, Pradhan GD, Shaw RF et al (1979), A village-scale trial of fenitrothion (OMS-43) at the reduced dosage of 1 g/m² for control of the malaria vector *Anopheles aconitus* in Central Java, Indonesia, WHO Document, WHO/VBC/79.738.


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria transmission in Nepal is generally confined to areas below 4000 feet of elevation, but malaria is detected throughout Nepal due to imported cases. The southern half of Nepal, the Terai, flattens out into tropical plains and tropical forests that merge with the Gangetic plains of India. Transmission is serious in the lower Terai (over 50% of all detected cases) where *An. annularis* is the vector. This species is resistant to DDT and dieldrin. In the forest area and inner Terai, *An. fluviatilis* and *An. maculatus* are secondary vectors. In the central Terai, *An. aconitus* and *An. culicifacies* are the vectors. The predominant species of malaria is *P. vivax* (95% of all cases).

In addition to the indigenous transmission, Nepal has a serious problem of imported malaria from India (about 25% of all cases detected, and increasing in the past three years). This is especially serious, because many of these cases are *P. falciparum* from areas of chloroquine-resistance. Indigenous drug-resistant malaria has not yet been detected in Nepal.

HISTORY OF ANTIMALARIA ACTIVITY

Antimalaria activities in Nepal began in 1954 as part of an Insect-borne Disease Control Project, followed by inauguration of the Rapti Valley Malaria Control Project in 1956, a WHO-sponsored pilot project of DDT residual spraying. The Nepal Malaria Eradication Organization (NMEO) was organized in 1958 as a vertical program that functioned with financial and technical assistance from USAID and WHO. It expanded to cover all malarious areas of Nepal with good success. By 1970, most malarious areas had entered consolidation phase.

Unfortunately, the period 1970-74 saw setbacks to the program resulting in a six-fold increase in recorded cases (2500 to 15,000): vector resistance to DDT and BHC developed; a number of administrative and operational problems including shortages of funds, of insecticides, of spray equipment, of transportation, and of spare parts; an increasing trend of imported cases from India; ecological changes at the sites of, and resulting from, development projects.

In 1975, the program was reviewed and revamped. The time-limited objective was replaced with a long-term malaria control program. Development aid from USAID, UNDP, and WHO was forthcoming, which together with increased budget support from the Government of Nepal, revitalized the antimalaria activities. The current objectives are to maintain the status quo/gains achieved and aim for eventual eradication in the future.
### Table 6-1.
Total Nepal Statistics
No. of Malaria Cases Recorded
No. of Blood Films Examined
Slide Positivity Rate (SPR)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Total Positives</td>
<td>12,370</td>
<td>10,123</td>
<td>11,972</td>
<td>14,317</td>
<td>12,131</td>
<td>14,148</td>
<td>16,085</td>
<td>16,907</td>
<td></td>
</tr>
<tr>
<td>No. Blood Films</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,560,233</td>
<td>1,389,417</td>
<td>1,323,861</td>
<td>1,289,793</td>
<td>1,493,423</td>
<td></td>
</tr>
<tr>
<td>SPR NMOE:</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.81%</td>
<td>0.83%</td>
<td>0.92%</td>
<td>1.1%</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>SPR ICHSD:</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.79%</td>
<td>1.37%</td>
<td>2.1%</td>
<td>2.6%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>API</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.72%</td>
<td>2.02%</td>
<td>2.2%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>ABER NMOE:</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15.2%</td>
<td>14.82%</td>
<td>16.82%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>ABER ICHSDP:</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.4%</td>
<td>6.6%</td>
<td>7.6%</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>%P.f.x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.5%</td>
<td>12.0%</td>
<td>6.7%</td>
<td>4.4%</td>
<td>6.2%</td>
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</tr>
<tr>
<td>No. of P.f.x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1510</td>
<td>1,461</td>
<td>9472</td>
<td>7112</td>
<td>1,0452</td>
<td></td>
</tr>
<tr>
<td>No. of P.v.x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13,1582</td>
<td>15,3642</td>
<td>15,8362</td>
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<tr>
<td>Total Pop. (million)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>14.102</td>
<td>15.022</td>
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<tr>
<td>Population at Malaria Risk (million)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.5022</td>
<td>8.7472</td>
<td>9.1462</td>
<td>9.473</td>
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Sources:
### Table 6-2

Malaria Statistics Stratified According to:

a) Highly Malarious Regions under National Malaria Eradication Organization

b) Less Malarious Regions under Integrated Health Services

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<tr>
<td>Total Positives</td>
<td></td>
<td></td>
<td>11,204</td>
<td>10,670</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Imported)</td>
<td></td>
<td></td>
<td>(3,598)</td>
<td>(3,117)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slides collected</td>
<td></td>
<td></td>
<td>1,386,734</td>
<td>1,292,291</td>
<td>1,161,583</td>
<td>1,161,110</td>
<td>1,336,981</td>
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<tr>
<td>SPR</td>
<td></td>
<td></td>
<td>0.81%</td>
<td>0.83%</td>
<td>0.97%</td>
<td>1.1%</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>API</td>
<td></td>
<td></td>
<td>1.97</td>
<td>1.84</td>
<td>1.7</td>
<td>2.0</td>
<td>2.2</td>
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<tr>
<td>ABER</td>
<td></td>
<td></td>
<td>24.3</td>
<td>22.1</td>
<td>15.2</td>
<td>14.8</td>
<td>16.0</td>
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<tr>
<td>%P.f.</td>
<td></td>
<td></td>
<td>13.1%</td>
<td>13.5%</td>
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<tr>
<td>No. of P.f.</td>
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<td></td>
<td>1,468</td>
<td>1,437</td>
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<td>9,736</td>
<td>9,233</td>
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<tr>
<td>Population (million)</td>
<td>5.7</td>
<td>5.8</td>
<td>6.11</td>
<td>6.26</td>
<td>6.53</td>
<td>5.9</td>
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<td><strong>IHS/IC/SDP Area</strong></td>
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<tr>
<td>Total Positives</td>
<td></td>
<td></td>
<td>3,113</td>
<td>1,461</td>
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<tr>
<td>(Imported)</td>
<td></td>
<td></td>
<td>(64)</td>
<td>(140)</td>
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<tr>
<td>Slides collected</td>
<td></td>
<td></td>
<td>173,499</td>
<td>106,420</td>
<td>162,278</td>
<td>128,688</td>
<td>156,442</td>
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<td>SPR</td>
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<td></td>
<td>1.77%</td>
<td>1.37%</td>
<td>2.1%</td>
<td>2.6%</td>
<td>1.3%</td>
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<td>API</td>
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<td></td>
<td>1.94</td>
<td>0.86</td>
<td>2.0</td>
<td>1.9</td>
<td>1.1</td>
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<td></td>
<td>10.84</td>
<td>6.28</td>
<td>8.4</td>
<td>6.6</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>%P.f.</td>
<td></td>
<td></td>
<td>1.35%</td>
<td>1.64%</td>
<td></td>
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</tr>
<tr>
<td>No. of P.f.</td>
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<td>42</td>
<td>24</td>
<td></td>
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<td></td>
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<tr>
<td>No. of P.v.</td>
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<td>3074</td>
<td>1437</td>
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<tr>
<td>Population (million)</td>
<td>1.6</td>
<td>1.7</td>
<td>1.723</td>
<td>1.815</td>
<td>1.928</td>
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Sources:
SCOPE OF MALARIA PROBLEM SINCE 1975

Morbidity and Mortality

The activation of the NMEO with a strategy of longterm control began in 1975 with increased funding (external aid and internal revenue). Malaria incidence dropped during the first two years (1975 and 1976). Since then incidence has generally increased. Increasing cases from the 9 outer Terai districts (which produced 53% of all cases in 1981) has been one problem, which has raised concern about the effectiveness of malathion spraying. Imported cases have also been increasing. Information on mortality due to malaria was not obtained.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM

DEPARTURES FROM TRADITIONAL STRATEGIES

Voluntary collaborators have been chosen in villages to collect blood slides and provide presumptive treatment to suspected malaria patients.

Some trials of larvivorous fish have been carried out.

DELIVERY SYSTEM NOW IN USE

Structure and staff

The malaria program of Nepal is a vertical, semi-autonomous program within the Ministry of Health with unipurpose malaria workers in those areas of Nepal with malaria incidence and transmission. There is a long-term plan to integrate antimalaria activities into the General Health Services in a phased manner, as malaria diminishes in various localities of the country. It is recognized that premature integration of malarious areas carries a risk of malaria resurgence.

The NMEO is governed by a semi-autonomous Board chaired by the Secretary for Health of the Ministry of Health. The Board gives direction to the chief officer of the NMEO, who is then responsible for the execution of the program. About forty percent of the population live in nonmalarious areas covered by the general health services, without any NMEO activities. About 15 percent of the population live in 14 districts where antimalaria activities come under the integrated health services, now called the Integration and Community Health Service Development Project (ICHSDP), but where the NMEO provides guidance and logistics support. The ICHSDP carries out the spraying, surveillance, and treatment, with planning, evaluation, commodity support, and special entomological units from the NMEO. The remaining areas are directly under the control of the NMEO, which functions as a conventional malaria control program. There is a remote malarious area in the Western hills (about 0.7 million population, 1983) that is not covered by regular antimalaria activities other than provision of drugs at treatment centers.

ACD/PCD

ACD is carried out by unipurpose malaria workers in the NMEO areas or by ICHSDP multipurpose health workers. The frequency of ACD house visiting:

-Weekly in development projects located in the highly receptive areas
-Fortnightly in the highly receptive areas without development projects
-Monthly in low receptive Terai areas
-Bimonthly or seasonally in certain hill districts with relatively low malaria risk.
Criteria for blood slide collection are past or present history of fever, or recent cross-border travel. Follow-up for 12 months is supposed to be carried out for all diagnosed malaria cases.

When supply of malathion for the spray cycles of 1983 was delayed, fortnightly ACD was initiated in the majority of the high incidence areas that could not be sprayed.

APCD (Activated Passive Case Detection) refers to any slides collected by malaria workers in the field outside of the regular schedule of ACD.

PCD refers to any slides collected by any static institutions, or voluntary collaborators (who are living in villages and supported by the NMEO). There are three subcategories according to source:
- PCD(H) from hospitals, health centers, health posts
- PCD(V) from voluntary collaborators
- PCD(M) from any malaria office at any level.

In town areas, Malaria Clinics are established in Zonal/District Hospitals or Health Centers, with a Laboratory Technician and a Malaria Field Worker who are NMEO staff. They collect and examine slides, carry out the epidemiological investigations, and provide radical treatment.

Epidemiological investigations are carried out of all confirmed malaria cases in all areas. This includes collection of blood slides in the course of a contact survey. Follow-up of all confirmed cases for 12 months is mandated.

Malaria Check Posts at borders collect blood slides from all persons entering from India.

Mass Blood Surveys are used in special circumstances, e.g., in a focal outbreak.

Method of Diagnosis and Coverage

Blood slides are examined in NMEO laboratories (Regional and District) by Malaria Laboratory Technicians.

The target for Monthly Blood Examination Rate (MBER) is 1.0%.
- The target for Annual Blood Examination Rate (ABER) is 10.0%.

Cross checking of slides is carried out at Regional laboratories (10% of the negatives and all positives). A second cross check of slides is carried out at Malaria HQ (10% of the 10% already checked).

Drug Protocols

All confirmed P. vivax and all indigenous P. falciparum cases receive radical treatment: chloroquine (1500mg divided over five days) plus primaquine (75mg divided over five days).

Radical treatment for all imported P. falciparum is sulfadoxine-pyrimethamine (Fansidar 2 tablets single dose) plus primaquine (45mg single dose).

Presumptive treatment is given at the time of blood slide collection (chloroquine 600mg).

At Kakarvitta Check Post in eastern Nepal, presumptive treatment (sulfadoxine-pyrimethamine 2 tablets, plus primaquine 30mg) is given to all fever cases entering Nepal from India.

Mass Drug Administrations are used in special circumstances in local foci of transmission, under guidelines to ensure high coverage and with clear objectives.
Spray Operations (frequency/insecticides used)

Malathion (2g/m², two cycles annually) is used in the outer Terai belt, where *An. annularis* is confirmed as the vector.

DDT (1g/m², two cycles annually) is used in the moderately receptive areas of forest and forest fringe of the Terai, the inner Terai, and hill valleys, where *An. fluviatilis* and/or *An. maculatus* transmit malaria. There are also some areas of low receptivity that receive one round annually of DDT spraying at 1.5g/m².

Residual insecticides are used in the following priority areas:
1) highly receptive areas (the Terai near forests, the inner Terai) with development projects.
2) highly receptive areas without development projects.
3) low receptive areas (cultivated plains of the Terai, hill valleys) with development projects.
4) low receptive areas without development projects.

An API of 0.5 (only indigenous cases) is the general criterion for withdrawal or continuation of spraying in a locality (of *10,000 population*).

Spray cycles are scheduled for the summer and autumn, and are supposed to last 50 days, including 7 days of training.

Focal spraying is carried out during the transmission season in villages with two or more indigenous cases.

Because of the high cost of residual insecticides and the developing status of insecticide resistance, the NMEO is endeavoring to reduce the use of insecticides in favor of any non-chemical antimalaria methods.

Type of Epidemiological and Entomological Data Available

The Plan of Action details a complete protocol for compilation and analysis of epidemiological data by the Planning, Statistics and Evaluation Section, which involves monthly, quarterly, and annual inputs.

Entomological studies are carried out in selected districts aimed at understanding the dynamics of malaria transmission in various ecological areas and monitoring the susceptibility status of vectors. A full variety of routine entomological activities are carried out to measure vector densities, insecticide susceptibility, feeding habits, and behavior.

Training Programs (pre-service and in-service)

Training facilities for malaria training are severely limited in Nepal. Nonetheless a number of courses are carried out. The Health Education Section carries out a variety of activities to promote prevention and control of malaria, including some training activities. Various staff of the NMEO are drawn to teach malaria courses at national, regional, and district levels.

Spray personnel, malaria field workers, laboratory technicians, and malaria inspectors are trained. Auxiliary health workers, Health Assistants and students from the National Development Services are given brief training on the control of malaria.

Training for professionals and semi-professionals is arranged outside the country.

A national annual seminar and workshop on malaria control is conducted as a method of continuous reorientation of the control activities and to review the progress of the program.
Training of staff in health promotion activities is carried out to gain community participation in the prevention and control of malaria (and other diseases).

Operations Research (in-house, universities, etc.)

There are plans to establish a Research and Training Section when facilities are available at Hetaura.

A number of research projects are in progress:
- Entomological studies are carried out in selected districts aimed at understanding the dynamics of malaria transmission in various ecological areas and monitoring the susceptibility status of vectors.
- Studies of An. aconitus, An. annularis, and An. culicifacies as species complexes is underway by cytotaxonomic methods.
- A study of indigenous larvivorous fish for larval control is planned.
- A field trial of Bacillus thuringiensis for larval control.
- A field study of mechanical control of An. annularis by removal of vegetation from breeding places is under way.
- Studies on effects of different drug regimens, specifically the in vivo relapse/recrudescence rates of P. vivax and P. falciparum cases treated with a single dose of: chloroquine (1200mg, in addition to the 600mg presumptive dose) plus primaquine (45mg); or sulfadoxine-pyrimethamine (Fansidar, 2 tablets) plus primaquine (30mg). A two-day regimen of chloroquine plus primaquine against P. falciparum and P. vivax is also under trial.
- Monitoring of chloroquine resistance in P. falciparum is under way.
- A study of G6PD deficiency of different ethnic groups.
- Impact of health education measures in selected areas.
- When supply of malathion for the spray cycles of 1983 was delayed, fort­nightly ACD was initiated in most of the high incidence areas. An e­valuation of that measure compared to malathion residual spraying will be carried out.

ANALYSIS OF OPERATIONAL PROBLEMS
INSECTICIDE RESISTANCE

Insecticide resistance is a major problem. In 1972, An. annularis was first incriminated as a vector in malarialogic areas of the Terai and also found to be resistant to DDT and dieldrin. Malathion residual spraying was substituted, but due to its high purchase cost and lesser residual effect (requiring more frequent applications), spraying has been limited to selected areas, not the entire range of the DDT-resistant vector, with adverse effects on malaria incidence. Because of the heavy expense for Nepal, the GON relies on external aid to purchase this commodity. In 1983, delivery was delayed resulting in non-spraying of many areas. The areas of An. annularis transmission have shown increased incidence over the past 5-6 years, suggesting problems.

An. culicifacies is also resistant to DDT.

An. fluvatilis and An. maculatus are susceptible to DDT. In areas without An. annularis, DDT residual spraying is used.
VECTOR BEHAVIOR

Vector behavior towards insecticides is a minor problem - there is some suspicion of avoidance of DDT.

SPRAY COVERAGE

Spray coverage (in the TOCOSURE sense) is a moderate to major problem. One recent report(1) states that 1982 spray operations achieved a "high percent coverage." Another report(5) states that the actual protective coverage in a house may be compromised: Houses are replastered one to several times per year; cooking inside houses coats the surfaces with soot and smoke.(5)

Both reports found that spray coverage in some districts may not be timed for maximum impact on seasonal peaks of malaria incidence. The first spray cycle of the year came after the first peak of transmission in the spring.(5)

The same reports also indicated that the selective belt spraying program leaves out large areas that should be sprayed and that are producing a large number of cases.

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1981</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>malathion</td>
<td>-</td>
<td>-</td>
<td>575,318</td>
</tr>
<tr>
<td>DDT</td>
<td>-</td>
<td>-</td>
<td>859,022</td>
</tr>
<tr>
<td>Autumn cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>malathion</td>
<td>-</td>
<td>-</td>
<td>569,531</td>
</tr>
<tr>
<td>DDT</td>
<td>-</td>
<td>-</td>
<td>800,913</td>
</tr>
</tbody>
</table>


DRUG RESISTANCE

Drug resistance has not appeared in Nepal, except as imported cases from India (chloroquine-resistant *P. falciparum*).

*P. vivax* is the predominant species of malaria in Nepal. Relapse is a problem, because radical treatment is not always attained.

QUALITY OF DIAGNOSTIC WORK

A recent report puts this work (Malaria Clinics, PCD by voluntary collaborators) as adequate to good.(1)

The ABERs of transmission areas are quite high.

QUALITY OF ENTOMOLOGICAL DATA

The routine entomological investigations carried out have been praised by a recent assessment report.
QUALITY OF EPIDEMIOLOGICAL DATA

A recent report states that the NMEO is collecting and reporting a large amount of epidemiological data in a clear, accurate, and timely manner.\(^1\)

The same report indicates that epidemiological investigations may be classifying many relapse cases erroneously as indigenous cases. They feel that the NMEO personnel need refresher training in case investigation techniques and classification.

QUALITY OF TRAINING PROGRAMS

Basic training and refresher courses for the various lower level health staff is adequate for orientation to antimalaria activities. Even though staff are available on an ad hoc basis, there is a need for training facilities and equipment, even of a modest nature (a building, slide projectors, demonstration materials, etc.).

There is no source in-country for training of upper echelon NMEO staff, or district health officers (who will eventually play an important role in malaria control after integration), in malaria control policy and methodology.

OTHER PROBLEMS

There is a shortage of trained manpower for the NMEO and difficulties in attracting and keeping experienced personnel, due to limited prospects of promotion, career development, and security.

People in many transmission areas have a habit of sleeping outdoors which negates the impact of residual spraying.

Transmission occurs in the forested belt of the Terai when people migrate there for wood cutting and collection of other forest products.

There is also a great deal of population movement across the border to India and back. About 25% of the total detected cases are imported from neighboring countries, due to the constant movement across the border. Most of these cases are \(P. falciparum\) and resistant to 4-aminoquinolines.

PROGRAM FINANCING

The high priority of the malaria control program is reflected in the Government of Nepal support:

- In 1977-78, 34.0% of the total national health budget
- In 1978-79, 33.1% of the total national health budget
- In 1979-80, 35.3% of the total national health budget
Table 5-5.
MCP Program Financing

<table>
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<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Host Government</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>$1,441,000</td>
</tr>
<tr>
<td>USAID</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(Rs.34,579,000)</td>
</tr>
<tr>
<td>WHO</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(Rs.33,600,000)</td>
</tr>
<tr>
<td>World Bank</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>$2,841,000</td>
</tr>
<tr>
<td><strong>In US $</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(Rs.68,179,000)</td>
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<tr>
<td><strong>Exchange Rate</strong></td>
<td></td>
<td></td>
<td></td>
<td>Rs.24-$1</td>
</tr>
</tbody>
</table>

STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

Nepal is a poor country with few resources. With reference to the malaria program, the first problem is procurement of malathion. Because of the heavy expense for Nepal, the GON relies on external aid to purchase this commodity.

POTENTIAL NEEDS FOR AID ASSISTANCE

- Commodity support
- Operational research
  - insecticides
  - larvicides
  - more inter-sectoral coordination
- Field Operations
  - Training - short and long term
    - intercountry (CDC, KL)
    - support for Training Center at Hitaura
    - provision of training equipment, facilities
    - training for trainers
- Program design, policy, implementation
- Technical Assistance
  - contract group for Integrated Health project should include one malaria/vector-borne disease specialist
- Epidemiology - stratification process/reporting/response
- Evaluation - yearly
- Donor coordination essential
  - conference is required with GON
BIBLIOGRAPHY - NEPAL


PAKISTAN

OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria in Pakistan is a serious problem, and unique in several ways compared to much of Asia: a) Urban malaria transmitted by An. stephensi (breeding in wells, containers, human-created water collections) emerged in the 1970s as a major factor in malaria prevalence; b) Multiple insecticide resistance in the principal vectors has become serious, severely limiting available interventions and raising costs for alternatives; c) There is a serious lack of morale, initiative, and operational efficiency of the malaria control program. The integration of the malaria program into the basic health services was premature, inadequately planned, and still unsuccessful; d) Another factor is the Afghan refugee situation, where malaria is second only to tuberculosis as the most important health problem.

Rural malaria is transmitted by An. culicifacies. Where rainfall is scarce (less than 10" annual precipitation - South of Punjab and Northern Sind), transmission is closely related to irrigation and its improper management. In the alluvial plains of the Punjab (with annual precipitation between 10-20"), the heavy monsoon rainfall that breaks the hot dry season is the predominant factor, subject these areas to epidemic outbreaks that have an approximate eight-year periodicity. Where rainfall is heavy (more than 20" annual precipitation - North of Punjab and most of North Western Frontier), malaria transmission is more or less stable.\(^{(2)}\)

Malaria occurs primarily in Punjab Province (most populous - 58% of the population, and most malarious), followed by Sind Province, the North West Frontier, and to a lesser extent Baluchistan Province. Urban malaria is significant in Karachi (in Sind).

HISTORY OF ANTIMALARIA ACTIVITY

Following a disastrous epidemic in 1908, a Central Malaria Bureau was established. Antimalaria activities during the period before Independence and Partition consisted chiefly of larviciding with oil or Paris green, limited to military sites and economically important towns. However, a great deal of epidemiological work established the parameters of malaria transmission, such as seasonality, relationship to rainfall, periodicity, vectors.\(^{(2)}\) When DDT became available in 1951, residual spraying was extended to some rural areas. The irregular use of DDT, in areas of high malaria prevalence and immediately after floods, continued until 1960, when the 14-year Malaria Eradication Program was launched. Intradomiciliary spraying of DDT twice annually began in the northeast districts in 1960 and gradually extended to the southwest. The entire country was covered by 1968, but at that time surveillance activities were relaxed. Coupled with emerging DDT resistance in the major vectors, a resurgence of malaria transmission reached epidemic levels in the early 1970s. USAID terminated support to the program in 1972, due to lack of adequate government support.\(^{(14)}\)

BHC was used during 1970-74 attempting to control the epidemics, but vector resistance developed quickly. The Five-Year Extension Plan was initiated in 1975, with increased GOP support, and USAID loans and grants. Malathion was introduced at this time. A tragedy with malathion intoxication occurred in 1976, resulting in several deaths of spraymen.\(^{(1)}\)
Figure 6-1.
Map of Pakistan showing distribution of rainfall.

Manpower for the program was planned to come from an integration of the malaria control program, and the smallpox and tuberculosis vertical services. This integration has not progressed smoothly. Furthermore, the Expanded Program for Immunization (EPI) and an oral rehydration program have become government priorities which take staff away from malaria control activities, sometimes at crucial periods (during spray cycles).

The New Extension Plan of the MCP was adopted for 1980-83, with USAID assistance.

SCOPE OF MALARIA PROBLEM SINCE 1975
Morbidity and Mortality

Reliable malaria incidence data is not available from Pakistan. Every available report emphasizes the inefficiency of the ACD system, and the lack of PCD. All data must be evaluated with a severe caveat as to their accuracy and precision. No mortality data was available.

Examining the annual incidence of malaria, it would appear that the Five-Year Plan of Operation (1975-1980) was successful in reducing malaria transmission. A sharp drop occurred in each year from 1976-79. The introduction of malathion for residual house spraying contributed to the drop. Confounding the analysis, however, were two other elements: 1) the surprise integration of the MCP into the general health services in 1977, which reduced the number of malaria staff and introduced an element of confusion into the program resulting in reduced efficiency of operations (such as surveillance), and 2) the past history of periodic epidemics at 8-year intervals (1972-73 may have been one of those peaks of incidence). In the period 1980-83, the SPR has increased each year, in spite of substantially higher slide examinations. Again it is not clear if the interpretation is confounded by some administrative or operational change, or epidemiological factors. The recent confirmation of chloroquine resistant malaria in the Punjab may be a factor.
Table 7-1.
No. of Malaria Cases Recorded
No. of Blood Films Examined
Slide Positivity Rate (SPR)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total No.</th>
<th>Positives</th>
<th>Blood Films</th>
<th>SPR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>238,315</td>
<td>122,219</td>
<td>47,571,238</td>
<td>7.43%</td>
</tr>
<tr>
<td>1976</td>
<td>16,160</td>
<td>17,707</td>
<td>12,304,122</td>
<td>4.28%</td>
</tr>
<tr>
<td>1977</td>
<td>2,682,257</td>
<td>3,006,624</td>
<td>3,018,458</td>
<td>1.78%</td>
</tr>
<tr>
<td>1978</td>
<td>47,571</td>
<td>37,923</td>
<td>3,249,051</td>
<td>0.62%</td>
</tr>
<tr>
<td>1979</td>
<td>12,304</td>
<td>55,497</td>
<td>2,563,945</td>
<td>0.46%</td>
</tr>
<tr>
<td>1980</td>
<td>12,304</td>
<td>49,188</td>
<td>2,563,945</td>
<td>0.59%</td>
</tr>
<tr>
<td>1981</td>
<td>17,707</td>
<td>37,923</td>
<td>3,249,051</td>
<td>1.26%</td>
</tr>
<tr>
<td>1982</td>
<td>37,923</td>
<td>55,497</td>
<td>2,563,945</td>
<td>1.71%</td>
</tr>
<tr>
<td>1983</td>
<td>55,497</td>
<td>49,188</td>
<td>2,563,945</td>
<td>1.92%</td>
</tr>
</tbody>
</table>

Sources:
3. USAID (1984), cable from AID/Islamabad mission.

N.B. Surveillance data are not reliable due to inefficiency of ACD system and grossly underutilized PCD system. The major defects of surveillance system have been reported in all ERT reports.
Figure 6-2.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM

DEPARTURES FROM TRADITIONAL STRATEGIES

The program seems to have difficulty implementing the traditional strategies.

DELIVERY SYSTEM NOW IN USE

Structure and staff

The GOP has turned from vertical health programs to an integrated primary health care approach under the Ministry of Health and Social Welfare. This establishment of a Communicable Diseases Control Program into which the MCP was merged along with other provincial health services occurred very suddenly. There was a reduction of about 200 staff. There is a Directorate of Malaria Control (DOMC) in the Ministry at Federal level that provides policy, guidance, and equipment and supplies, but the anti-malaria activities are implemented by the Provincial governments that pay salaries and wages. Integration of the malaria program into the general health services has been slow. Several reports state that administrative integration has occurred but not functional integration, meaning that malaria activities are still performed by unipurpose malaria personnel, not the multipurpose health workers. Although the integration plan has resulted in fewer malaria staff, the antimalaria measures are still performed largely by this group. Furthermore, other health projects (EPI and ORT) currently have higher priority and co-opt malaria staff. (12), (2)

Urban malaria control activities are the responsibility of each municipality. The DOMC provides insecticides, larvicides, equipment, and vehicles, but the municipalities provide manpower and administration.

ACD/PCD

Blood films are collected in rural villages by malaria agents (Malaria Supervisors, now called CDC Supervisors) on a monthly schedule. Each Supervisor works in a sub-sector of 3000-3500 houses, population of 15,000-18,000. This ACD accounts for 90% of all blood slides. (2),(12)

PCD from hospitals, dispensaries, and other health facilities is small and has resisted repeated recommendations and efforts to increase it. Slides collected are sent to district laboratories for examination.

Malariometric surveys are carried out from time to time. Criteria are not known.

Case investigations are carried out in a selective manner depending on manpower.

Surveillance data are not reliable due to the inefficiency of ACD system which is carried out by the Malaria Control Program, and a grossly underutilized PCD system. Although integration of health activities is an objective of the GOP, there is still poor coordination between the preventive and curative services. The major defects of the surveillance system have been reported in the ERT report of 1983, as well as earlier reports. (12)

Method of Diagnosis and Coverage

Laboratory services are provided in each district to examine the blood slides collected from ACD and PCD.
In the health centers and hospitals, very few blood slides are collected, therefore the diagnosis and treatment of malaria cases is probably made on clinical grounds. No statistics are available.

A reference laboratory is set up in Lahore to cross-check the efficiency of district laboratories.\(^{12}\)

**Drug Protocols**

- Presumptive treatment is given in a single dose at the time of blood slide collection.
- Radical treatment for confirmed cases of *P. falciparum* is chloroquine divided over three days.
- Radical treatment for confirmed cases of *P. vivax* is chloroquine divided over five days.\(^{12}\)

**Spray Operations (frequency/insecticides used)**

Malathion (2g/m\(^2\); but in a few areas 1.5g/m\(^2\)) is the principal insecticide for residual house spraying in rural areas. Twice annual spraying occurs, but reports state that scheduling is purely a bureaucratic and logistical exercise without any regard to epidemiological or biological criteria.

In a few areas DDT or dieldrin are still used. Because malathion resistance has appeared in some districts, alternative insecticides are under trial. Fenitrothion has been used in some localities. Recently a trial of pirimiphos-methyl (Actellic 25 WP) was conducted in Punjab Province,\(^5\) with encouraging results.

Spraymen are hired locally at the time of spray cycles. They receive 1-2 days of training on safety and proper spray techniques. Uniforms and equipment are issued. Baseline levels of cholinesterase are determined, but apparently not systematically. Spray coverage is supposed to include all rooms of each house and the ceiling.

In urban areas, malaria control is carried out as an insect pest control program using larviciding and ULV insecticiding, without any evaluation or implementation based on epidemiological data.

Given the history of insecticide resistance in Pakistan, the abysmal spray coverage achieved, and the lack of any reliable epidemiological evaluation, this intervention measure really needs serious reevaluation.

**Type of Epidemiological and Entomological Data Available**

The lack of reliable epidemiological data is a major deficiency of the malaria control program. The need for implementation of a surveillance system was listed in a 1983 evaluation report.

Entomological data is available: routine vector density monitoring is collected throughout the country, but is not organized and analyzed. Insecticide susceptibility testing data is available for DDT, dieldrin, malathion and fenitrothion.

**Training Programs (pre-service and in-service)**

There is a National Malaria Training Center housed in modest quarters which carries out training of malaria and general health personnel. Pre-service and in-service refresher courses are offered to junior and senior malaria staff, microscopists. Special courses have been conducted, such as on epidemiology, urban malaria control, insecticides.\(^{14}\),\(^{12}\)
Operations Research (in-house, universities, etc.)

The National Malaria Training Center has carried out operational research for the past 20 years. Under the current AID Project funding, a research unit has recently been established to address basic and operational research.\(^{(12)}\)

The Pakistan Medical Research Center in Lahore is a research station of the University of Maryland. At one time this center was funded under the International Centers for Medical Research program (ICMR) of the National Institutes of Health (NIH/USA). In the past this center has conducted important research on the bionomics and genetics of An. culicifacies and An. stephensi, as well as epidemiologic field studies, but budgetary and other non-scientific matters have intervened. Its current status is believed to be modest.\(^{(12)}\)

The National Institute of Health in Islamabad has a malaria research project underway.\(^{(12)}\)

**ANALYSIS OF OPERATIONAL PROBLEMS**

**INSECTICIDE RESISTANCE**

Insecticide resistance is a major problem. An. culicifacies and An. stephensi are completely resistant to the chlorinated hydrocarbon insecticides (DDT and dieldrin) (using the standard WHO 1-hr discriminating dose tests).\(^{(8),(6)}\) These insecticides are still used in a few limited areas.

Malathion resistance in An. stephensi was reported in 1980,\(^{(7)}\) and recently has been reported in An. culicifacies in Punjab Province.\(^{(5)}\) This insecticide is currently in use by the MCP/Pakistan.

It is planned to introduce the use of fenitrothion (another O-P compound) when significant resistance to malathion is detected. Some limited use of this insecticide is underway.

This progression points up a severely negative aspect of longterm spraying, in that assets (effective insecticides) are used up.

**CHANGES IN VECTOR BEHAVIOR**

There is no data available on changes in vector behavior.

Operational research is proposed on vector behavior, starting with preferred resting sites. Frequent resting in animal shelters is reported. If verified, this could suggest a change in spraying strategy to exploit a preferred resting site. It is not clear why data on preferred resting sites is so tenuous at this late date of the spray operations.

**SPRAY COVERAGE**

Spray coverage is a major problem. MCP reports on spray coverage appear highly satisfactory (over 90% of projected quota of houses), but external evaluation reports state that these figures are not reliable, both in gross numbers and in efficiency of coverage. Totally sprayed house coverage is over-reported (partial coverage is the norm); defective nozzle tips do not deliver the correct dosage; house owners frequently wash off the insecticide after spraying (complaining of odor or appearance).
Table 7-2
Spray Coverage in Control Areas

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Coverage</td>
<td>84%</td>
<td>81%</td>
<td>77%</td>
<td>57%</td>
</tr>
<tr>
<td>(Proportion of existing houses projected to be sprayed)</td>
<td>(28%)</td>
<td>(13%)</td>
<td>(13%)</td>
<td>(26%)</td>
</tr>
</tbody>
</table>

Source: Data provided by USAID mission

Areas for spraying are occasionally selected on non-technical basis. Because of the acknowledged unreliability of the surveillance data (refer to 1983 External Review Report, Part I), areas to be sprayed were determined more by the anticipated availability of insecticide than by precise data pinpointing areas of need.

It is reported that spray operations have many deficiencies: lack of adequate uniforms for spraymen; lack of proper equipment, such as funnels with sieve, and buckets; spray cans old and lacking any spare parts; nozzle tips grossly defective or worn; no standard measure of insecticide - it is measured out haphazardly in the field by the spraymen; insecticide is stored and mixed at the water source; cleaning and rinsing is carried out at the water source.

Inadequate field supervision is the principal cause of poor spray performance: the Expanded Program on Immunization (EPI) draws away supervisors during spray season; travel allowances are fixed at an extremely low level; motorbike fuel allowance is inadequate in some areas. Without adequate field supervision, spraymen work in a perfunctory way to meet quotas as quickly as possible, while the spray team supervisor overreports to make his reports acceptable.

DRUG RESISTANCE

Drug resistance is currently a minor problem, but the potential for it to expand is already present. Chloroquine resistant *P. falciparum* has been confirmed recently in the Punjab Province. During Oct. 1983-Jan. 1984, WHO extended 28-day in-vivo tests have confirmed a low prevalence (2 of 60 cases, at RI level) of chloroquine-resistant *P. falciparum* in Jhang District, and a higher prevalence was detected in Bahawalnagar District (15 of 31 cases; 14 at RI level, 1 at RII level).

Although the AID/Islamabad mission comments that chloroquine-resistant falciparum malaria is not yet perceived as a problem, this could change drastically, if resistant strains are allowed to spread as a result of the MCP's inability to contain falciparum transmission due to the continued inefficiency of program operations.

The WHO in-vitro micro test will be used, beginning in September 1984, to determine susceptibility levels in falciparum areas. In vitro testing of pyrimethamine susceptibility will also be carried out.
There is no test data on susceptibility of falciparum strains to Fansidar.

QUALITY OF DIAGNOSTIC WORK
Information was not available.

QUALITY OF ENTOMOLOGICAL DATA
Routine entomological observations of vector densities are carried out in great number, resulting in an enormous amount of information that is reliable. Unfortunately this data is collected but not organized or interpreted. The original purpose for the collection of mosquito density statistics was to provide information for correct timing of spray cycles and evaluation of insecticidal impact. This is not happening.

There is a need for retargeting of vector sampling in a few indicator localities. More information on vector behavior is needed: daytime resting preferences of vectors; priority surfaces to be sprayed.

The Pakistan Medical Research Center, associated with the University of Maryland, has carried out excellent studies on vector genetics, bionomics, and vectorial capacity.

QUALITY OF EPIDEMIOLOGICAL DATA
This is reported as extremely deficient, such that a true picture of the epidemiological situation is not available. Spray operations are planned on the basis of supply and logistics rather than any evidence of malaria incidence.

It is reported that collecting blood slides from females is a problem in many areas. Females rarely appear at health facilities that do not have female health personnel, and male surveillance workers may not obtain blood slides from females.

QUALITY OF TRAINING PROGRAMS
Information was not available.

OTHER PROBLEMS
Safety: insecticides (malathion and fenitrothion) are stored and mixed at the water source; rinsing and cleaning is carried out at the water source; supervisors usually carry atropine to antidote insecticide poisoning, but do not always carry syringes, nor do they all know how to inject the drug; cholinesterase levels are monitored in most districts, but cases of spraymen with extremely low levels and symptoms have been reported still applying fenitrothion. Follow-up of spraymen who are sent home is not carried out. It is reported that enforcement of safety precautions has been relaxed.

Lack of spare parts for spray operations has been a problem.

PROGRAM FINANCING:
When the five-year plan of operation for the new MCP was begun in 1975, the budget of Rs.215 million represented approximately one-third of the federal health budget, making the MCP the most important national health program. Budget support continues to be a large portion of the health budget.(2)
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<tbody>
<tr>
<td><strong>Host Government</strong></td>
<td>-</td>
<td>-</td>
<td>$1,010,101</td>
<td>$2,076,913</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td><strong>WHO</strong></td>
<td>-</td>
<td>-</td>
<td>160,750</td>
<td>160,750</td>
<td>175,000</td>
<td>175,000</td>
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<td><strong>AID</strong></td>
<td>-</td>
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<td>2,344,730</td>
<td>0</td>
<td>1,082,264</td>
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<tr>
<td><strong>Govt. of Japan</strong></td>
<td>-</td>
<td>-</td>
<td>4,040,404</td>
<td>3,282,828</td>
<td>2,020,202</td>
<td>0</td>
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<tr>
<td><strong>UNICEF</strong></td>
<td>-</td>
<td>-</td>
<td>12,200</td>
<td>12,200</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>-</td>
<td>-</td>
<td>$7,568,185</td>
<td>$5,532,691</td>
<td>$4,277,466</td>
<td>$6,553,243</td>
</tr>
</tbody>
</table>

In U.S. dollars

<table>
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<td><strong>Exchange Rates</strong></td>
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<td>-</td>
<td>(9.90Rs=$1)</td>
<td>(9.90Rs=$1)</td>
<td>(10.89Rs=$1)</td>
<td>(12.90Rs=$1)</td>
</tr>
</tbody>
</table>

Source: USAID (1984), cable from AID/Islamabad mission.
STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

The Pakistan antimalaria program requires a kind of assistance that may not be donatable, viz., management. All available reports emphasize that:

Epidemiology and surveillance are very deficient.

Spraying is no more than partially effective (whatever that may mean) due to lack of total, complete, sufficient, and regular coverage. Furthermore the spraying is not based on vector bionomics or epidemiological analysis.

Insecticide susceptibility testing is carried out in a random and haphazard way, rather than systematically.

Safety precautions and procedures need upgrading (since the program is using hazardous insecticides).

Upgrading and development of epidemiological capabilities is needed. Evaluation and analysis, as well as the collection of data, needs help.

The reliance on residual insecticides and the emerging resistance to malathion (in addition to existing DDT and dieldrin resistance) augurs poorly for the MCP. Not only will costs escalate dramatically, but the availability of effective countermeasures to epidemics is disappearing. Serious thought and operational research is needed to consider and evaluate alternative strategies, such as personal protection, community-based anti-larval measures, community-based surveillance and treatment, and epidemiological monitoring of epidemic potentials.

In order to maintain the reduction in malaria incidence, routine residual insecticiding is currently planned through 1987, an extension of the previous plan to end use in 1983. Pakistan has relied on foreign commodity support from Japan and the USA in order to carry out the spray program. If spraying is considered necessary, continued commodity support will be necessary.

Although the National Malaria Training Center has carried out a modest program of operational research, many planned projects are yet to get off the drawing board. This facility needs support for building, equipment, and supplies. Fellowship support for training of health staff is needed. A limited number of fellowships for American researchers (both pre- and post-graduate) to carry out research projects in Pakistan would offer benefits to both Pakistan and the USA, by offering field research opportunities to Americans and access to the latest research methods and techniques in the USA. Operational research on vector control needs support and assistance.

Technical Assistance - long and short term
- training
- research
- vector control
- logistics
- epidemiology
- program design/policy/implementation
Training
- upgrading of physical facilities
- teaching materials and equipment
- training of trainers in newest methods

Operational Research
BIBLIOGRAPHY - PAKISTAN


OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Anti-malaria activities in the Philippines have been carried out since the early 1920s. Since the 1950s, malaria control/eradication activities have been subject to frequent review and reorganization. Recently, these antimalaria activities have been integrated into the national primary health care program, which relies on the Barangay Health Worker (BHW) at the most peripheral level of the health system, and community participation.

There are large constraints to successful antimalaria operations in the Philippines including: (10) a vast archipelago of 7000 islands with many inaccessible areas, a security problem in many of the malarious rural areas, inadequate financial support, extensive population movements within malarious areas and between malarious to non-malarious areas, active and passive refusal of DDT house spraying, man-made changes in mosquito ecology (irrigation schemes), and chloroquine-resistant \textit{P. falciparum}.

Transmission of malaria occurs in rural areas, mostly in the foothills and mountainous areas, where the principal vector \textit{An. minimus flavirostris} breeds in clear, slow-flowing hill streams. The forest fringes where settlers live in substandard housing is an important site of transmission by this vector. This vector developed resistance to dieldrin in 1959. Transmission by \textit{An. litoralis}, a brackish water breeder, occurs in island coastal areas. \textit{An. balabacensis balabacensis} on Palawan Island, \textit{An. mangyanus} in Mindanao, and \textit{An. maculatus} are three other secondary vectors.

Drug-resistance to chloroquine and amodiaquine is a rising problem.

HISTORY OF ANTIMALARIA ACTIVITY

The anti-malaria program in the Philippines has been reorganized many times during its existence. (3)(10)

Malaria control (sanitary engineering and larviciding) began in the Philippines in 1920/21 with assistance from the Rockefeller Foundation. The Malaria Control Section of the Bureau of Health was organized in 1926.

In 1952/53, a Malaria Control Pilot Project was sponsored by the WHO to test indoor residual spraying of DDT. A nationwide control program was launched that expanded into a malaria eradication program within the framework of the general health services. Success was dramatic with malaria incidence dropping "from 100% to 10-15%." (3) During this period dieldrin was used for 2 years, but the principal vector became resistant, causing reversion to DDT. (3)

In 1959, the Department of Health decentralized its operations. The result for the malaria eradication program was insufficient central direction and control of the program. Malaria cases steadily increased.

The malaria eradication program was reorganized into a vertically oriented Malaria Eradication Service in 1966, to counter its problems of implementation in the changing and decentralized health services. In 1969, the program was redefined from a time-limited eradication program to an open-ended program concentrating on selected areas of high endemicity. While technical justifications were given, equally important was lack of sufficient operating funds.
In 1970-71, the program was reviewed with new delimitation of operational areas. Areas of low malaria incidence were scheduled for integration into the general health services, i.e., in the absence of transmission, spraying by the Malaria Service was unnecessary, and PCD, radical treatment, and case investigation would be the responsibility of the general health staff.

Until phasing out in 1973, USAID supplied all the vehicles, DDT, spray cans, and the drugs. The Philippine Government provided personnel and maintenance. The WHO gave technical assistance, some drugs and some microscopes.

In 1973-74, another review placed all malarious areas under one of two defined antimalaria categories: malaria control, or malaria eradication. In 1976, the strategy was further modified to incorporate phases: of 14.8 million people living in areas covered by antimalarial activities: (1) (9)

- 41% in areas under attack operations (spraying)
- 17% in areas under surveillance (with low malaria incidence)
- 42% in areas in the pre-maintenance phase with no regular measures other than PCD

Thus the program became a hybrid of open-ended "control" strategy using time-limited eradication tactics and terminology.

In 1975, a pilot project on Malaria Integration was started in two provinces and expanded in 1977. In 1978, at assessment, integration into the general health services was recommended for areas of low malarialogenic potential. Rural Health Units gradually extended their coverage to the entire country. Integration of antimalaria activities into the national primary health care program was completed in 1982/83. The Barangay Health Worker (BHW) is the most peripheral staff of this integrated multipurpose health care delivery scheme. It is too early to evaluate the effectiveness of this change, but reported side effects have been the demoralization of the Malaria Service staff and a bogging down in the malaria reporting system such that current epidemiological data are not considered reliable. (8)

**SCOPE OF MALARIA PROBLEM SINCE 1975**

**Morbidity**

Compared to older estimates from the pre-DDT period, malaria has decreased over the last two decades as one of the major public health problems. Nonetheless according to WHO statistics, (9) malaria was the fourth leading cause of infectious disease in 1977 and 1978 (coming after influenza, intestinal infections, and tuberculosis) (more recent statistics were not available).

**Mortality**

In 1951, malaria occupied the first place among the common causes of mortality. By 1972, malaria morbidity had fallen to the 6th place, and malaria mortality is no longer one of the 10 leading causes of death. (10) The reasons for this drop were multifactorial: development of health and medical facilities, better housing, rapid advances in agriculture and industry, extensive infrastructure development, urbanization, and antimalarial measures. (1)
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Positives(^1)</td>
<td>72,675</td>
<td>-</td>
<td>-</td>
<td>104,826</td>
<td>115,673</td>
<td>96,725</td>
<td>96,776</td>
<td>84,844</td>
<td></td>
</tr>
<tr>
<td>Total Malaria Cases(^2)</td>
<td>72,675</td>
<td>72,711</td>
<td>86,553</td>
<td>104,826</td>
<td>105,750</td>
<td>97,557</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>No. Blood Films</td>
<td>1,131,386</td>
<td>-</td>
<td>-</td>
<td>1,004,006</td>
<td>949,909</td>
<td>794,946</td>
<td>910,976</td>
<td>696,570</td>
<td></td>
</tr>
<tr>
<td>Slide Positivity Rate (SPR)</td>
<td>6.4%</td>
<td>5.5%</td>
<td>10.4%</td>
<td>8.7%</td>
<td>12.2%</td>
<td>12.2%</td>
<td>10.6%</td>
<td>12.2%</td>
<td></td>
</tr>
<tr>
<td>No. of P. f.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>67.6%</td>
<td>63.6%</td>
<td>62.1%</td>
<td>64.2%</td>
</tr>
<tr>
<td>No. of P. f.(^*)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>78,171</td>
<td>61,487</td>
<td>60,134</td>
<td>54,464</td>
</tr>
<tr>
<td>Malaria Mortality(^3)</td>
<td>1,018</td>
<td>997</td>
<td>974</td>
<td>1,077</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rate/100,000</td>
<td>2.4</td>
<td>2.3</td>
<td>2.2</td>
<td>2.2</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Sources:
\(^1\) Data provided by Philippines Ministry of Health, Malaria Control Service, to AID/Manila.


N.B.: In 1983, the Malaria Control Program was fully integrated into the primary health care (PHC) system. The Malaria Control Program staff claim that malaria reporting broke down when the integration was effected, thus the 1983 data are substantially inadequate.
REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM

DEPARTURES FROM TRADITIONAL STRATEGIES

Full integration of antimalaria activities into the general health services has been implemented. Community participation in antimalaria activities is part of the overall strategy.

Community participation in environmental management is being undertaken, such as altering of vector breeding sites.

DELIVERY SYSTEM NOW IN USE
Structure and Staff

Currently the malaria program is integrated into the primary health care system. The Malaria Eradication Service staff remain part of the health service, but operational activities are carried out by the multipurpose health staff and the local communities.
ACD/PCD

ACD, mass blood surveys, and case investigations are carried out. The Barangay Health Worker (BHW) plays a major role in these activities.

PCD is carried out by health institutions such as district hospitals.

Method of Diagnosis and Coverage

Blood slides collected by the BHW are examined at district hospitals.

Drug Protocols

No current information.

Spray Operations (frequency/insecticides used)

Under the current program of antimalaria activities completely integrated into the general health services, spraying of DDT is conducted by local people through contracts between the Malaria Service and barangay (village) captains. Spraymen are trained by Malaria Service staff and paid Peso 2.50 per house sprayed (US 14c).(8)

Type of Epidemiological and Entomological Data Available

No current information.

Training Programs (pre-service and in-service)

An International Malaria Eradication Training Center was established in 1963 as a joint undertaking of the Republic of the Philippines, USAID, and WHO. This center trained malaria eradication personnel from countries throughout the Asian region. In 1973, international funding was cut, and it became the Malaria Eradication Training Center under the Ministry of Health. Courses for the training of professional and subprofessional staff were carried out. Current status under integration is not known.

Operations Research (in-house, universities, etc.)

No current information.

ANALYSIS OF OPERATIONAL PROBLEMS

INSECTICIDE RESISTANCE

Insecticide resistance is a minor problem. Though resistance to dieldrin was recognized in 1959, the principal vector An. minimus flavirostris is still susceptible to DDT.(8) Tolerance to DDT has developed in some secondary vectors such as An. litoralis.(4)

VECTOR BEHAVIOR

Vector behavior is considered a minor problem, because of the exophilic behavior in the secondary vector An. balabacensis.

SPRAY COVERAGE

The human population is very resistant to indoor spraying of their houses. Ten years ago it was reported that persuasion was not effective, or where spraying could be effected, the insecticide was washed off the walls immediately after the sprayman departed ("wiping out")(3)
Under the current program of antimalaria activities completely integrated into the general health services, spraying is conducted by local people through contracts between the Malaria Service and barangay (village) captains. Spraymen are trained by Malaria Service staff and paid Peso 2.50 (US 14¢) per house sprayed.\(^7\)

### Table 8-2.
Spray Coverage in Control Areas\(^1\)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent coverage</td>
<td>—</td>
<td>91%</td>
<td>89%</td>
<td>92%</td>
<td>85%</td>
</tr>
</tbody>
</table>

1 Control areas are areas of continuing malaria transmission under regular spray operations.

Source: Data provided by Philippines Ministry of Health, Malaria Control Service, to AID/Manila.

### Drug Resistance

Drug resistance is a major problem. Resistance to chloroquine was reported in 1977, and is now well documented in Luzon, Mindoro, and Palawan.\(^2,2\) Resistance to quinine has been recently reported.\(^7\) Increased chloroquine dosage or sulfadoxine-pyrimethamine (Fansidar) is used as a substitute.

### Quality of Diagnostic Work

No current information.

### Quality of Entomological Data

No current information.

### Quality of Epidemiological Data

This is reported to have broken down since completion of the recent integration process.

### Quality of Training Programs

No current information.

### Other Problems

Integration of the malaria program into the Primary Health Care system appears to be a problem. Whether this is a transient or more resistant problem is not yet clear. In the past, lack of community participation was mentioned as a problem.
Lack of security in rural areas is a continuing problem that does not appear to have an early solution. The peace and order situation at times makes application of antimalaria measures difficult.

Operational inaccessibility and difficult terrain of some areas has affected regularity of instituting measures and supervision.

Extensive population movements between malarious and malaria-cleared areas makes maintenance of gains difficult.

Man-made ecological changes, especially extensive irrigation projects have created more breeding sites for vectors.

In the past, problems related to budget and finance were listed: inadequate financial support; disruption of budgetary cycles and processes by unexpected restructuring of programmed allotments for maintenance and operation expenses; no incentive pay for difficult field conditions; hazard pay only given in areas with security problems; vehicle replacement not implemented; cost of repair and maintenance of old motor vehicles. It is not clear whether integration has solved these problems.
### Table 8-3.
Malaria Program Financing

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Government</td>
<td>P.23 million</td>
<td>P.27 million</td>
<td>P.27 million</td>
<td>- 2</td>
</tr>
</tbody>
</table>

No external financing

Sources:
1. in Pesos
2. USAID staff report that Malaria Control budget is now fully integrated into the Primary Health Care Program budget and cannot be broken out.
STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

The Philippine malaria program has been merged into the general health services and the operational activities are now handled by multipurpose health workers. Local-hire spraymen are used for spraying, trained by malaria staff and supervised by the MHWs. This integration is one of the most complete such exercises described in this report. Early problems have been reported. This may need attention from PHC and management specialists. This program may also be worthy of study as a test case of full integration of vertical health program activities into the general health services.

POTENTIAL NEEDS FOR AID ASSISTANCE

Training
- graduate level training for selected candidates
- health education and community participation
- technical training in newest methods of diagnosis
  - serological
  - entomological
- program management
- integration strategy and management
- support for the National Training Center

Operational research
- drug resistance of P. falciparum
- implementation and effectiveness of health service integration
- community-based vector control

Technical assistance
- public health integration and PHC
- vector control
- training techniques
- computerization of data and statistics
BIBLIOGRAPHY - PHILIPPINES


8. USAID (1984), cable from AID/Philippines mission.


INTRODUCTION

Sri Lanka has become a textbook example of the difficulty in attaining and maintaining malaria eradication. Following the introduction of an eradication campaign in the 1950s, malaria virtually disappeared in the early 1960s, according to the epidemiological data. In 1963, at the height of a malaria eradication campaign, total recorded cases were 17. At that point the eradication effort was relaxed due to high cost and a false hope that eradication had been achieved. Within 3 years, cases had soared to many hundred thousands.

The principal vector is An. culicifacies, a mosquito that is highly adaptive to various breeding sites. Classic epidemics in Sri Lanka are associated with droughts that leave water pools in and near river beds, but many various water pools can be suitable for breeding.

Insecticide resistance necessitates use of malathion, which may too be losing effectiveness. On the other hand there is as yet no evidence of drug resistant malaria.

The current deterioration of security and civil stability in 1984-85 will probably have adverse effects on antimalaria operations in Sri Lanka.

HISTORY OF ANTIMALARIA ACTIVITY

There is a long history of malaria epidemics in Sri Lanka that seem to come at three to five year intervals. Limited antimalaria measures were practised during the 1920s in urban areas: antilarval measures such as maintenance of drains, filling and draining, oiling of breeding sites. Seasonal distribution of quinine was also carried out. After the great epidemic of 1934-35 (with 80,000 deaths and several million malaria cases), antimalaria measures were expanded to cover rural areas.

Residual DDT spraying began in 1945. BHC and dieldrin were also used. There was a very good response with a steady decline of malaria morbidity and mortality. This encouraged the institution, in 1958, of a malaria eradication program to deal with the residual foci of malaria. In 1963, only 17 cases were recorded, leading to the withdrawal of spraying in 1964, putting the program into a consolidation phase. In retrospect this was obviously premature and based on incomplete epidemiological data. From unchecked foci of transmission, an explosive epidemic occurred in 1968-69 in the traditional malarious areas. An emergency program of DDT spraying and case treatment became operative in 1968 and gradually checked the epidemic.

However, DDT resistance had been developing and by 1975 malaria transmission was unchecked again. This led to the substitution of malathion for residual spraying. This, plus intensified efforts and greater expenditures, brought malaria transmission down, but never close to the near-eradication levels. Since then the Anti-Malaria Campaign (AMC) has functioned as a malaria control program using all of the available antimalaria tactics.
SCOPE OF MALARIA PROBLEM SINCE 1975

Morbidity

Malaria incidence in 1975 was the peak of incidence in the last country-wide epidemic outbreak which resulted in the substitution of malathion for residual spraying. Since then annual incidence declined steadily until stabilizing during 1979-82. In 1983, incidence has jumped sharply, due to population movements and climatic conditions favorable to malaria transmission.

In 1982, 58% of the total number of cases (and 68% of the Pf cases) were from 10 health areas, while 21 health areas were responsible for 80% of the total cases (out of 108 health areas in Sri Lanka). All these areas are located in the Northern dry belt and the Eastern foothills.

Under-five year olds accounted for 13.75% of all cases in 1982 (almost identical in 1981). A large number of infants in Anuradhapura had malaria (more than 25% of total cases in infants occurred here).

Mortality

In the reports of the AMC, there have been a handful of deaths due to malaria reported in most years since 1975. Another source of mortality data is from the Registrar General, which differs substantially (larger). It is believed that the explanation is the lack of communication between the hospital system and the AMC. The hospitals collect and examine only a small number of blood slides and do not systematically report fever cases to the AMC. Therefore, deaths due to malaria may be declared on clinical diagnosis, and in any case may not be reported to the AMC.

Table 9-1.
Age and Sex Distribution of Positive Cases

<table>
<thead>
<tr>
<th></th>
<th>1978</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Males</td>
<td>41,635 (59.7%)</td>
<td>24,697 (64.0%)</td>
</tr>
<tr>
<td>Females</td>
<td>28,050 (40.3%)</td>
<td>13,869 (36.0%)</td>
</tr>
<tr>
<td>under 1 yr</td>
<td>646 (0.9%)</td>
<td>432 (1.1%)</td>
</tr>
<tr>
<td>1-5 yrs</td>
<td>7020 (10.1%)</td>
<td>4,874 (12.6%)</td>
</tr>
<tr>
<td>6-9 yrs</td>
<td>15,313 (22.0%)</td>
<td>3,502 (9.1%)</td>
</tr>
<tr>
<td>6-15 yrs</td>
<td>4,770 (12.4%)</td>
<td>4,770 (12.4%)</td>
</tr>
<tr>
<td>9-15 yrs</td>
<td>46,706 (67.0%)</td>
<td>24,988 (64.8%)</td>
</tr>
<tr>
<td>over 15 yrs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 9-2.
**No. of Malaria Cases Recorded**
**Slide Positivity Rate (SPR)**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Positives</td>
<td>400,777</td>
<td>304,487</td>
<td>262,460</td>
<td>69,685</td>
<td>48,004</td>
<td>47,949</td>
<td>47,383</td>
<td>38,566</td>
<td>127,264</td>
</tr>
<tr>
<td>No. Blood Films</td>
<td>1,492,008</td>
<td>1,408,644</td>
<td>954,756</td>
<td>968,327</td>
<td>1,001,217</td>
<td>803,692</td>
<td>892,143</td>
<td>1,127,605</td>
<td>1,055,626</td>
</tr>
<tr>
<td>SPR</td>
<td>26.9%</td>
<td>21.6%</td>
<td>27.2%</td>
<td>7.2%</td>
<td>4.7%</td>
<td>6.0%</td>
<td>5.3%</td>
<td>3.4%</td>
<td>12.05%</td>
</tr>
<tr>
<td>API (permille)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.533</td>
</tr>
<tr>
<td>ABER (slides/100 pop)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.46</td>
</tr>
<tr>
<td>x P.f.</td>
<td>15.5%</td>
<td>6.0%</td>
<td>4.0%</td>
<td>2.6%</td>
<td>2.7%</td>
<td>3.0%</td>
<td>2.6%</td>
<td>4.7%</td>
<td>3.4%</td>
</tr>
<tr>
<td>No. of P.f.</td>
<td>336,924</td>
<td>285,690</td>
<td>251,726</td>
<td>67,909</td>
<td>46,636</td>
<td>46,474</td>
<td>46,143</td>
<td>36,967</td>
<td>122,764</td>
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<tr>
<td>No. of P.f.</td>
<td>62,071</td>
<td>18,206</td>
<td>10,431</td>
<td>1,826</td>
<td>1,313</td>
<td>1,423</td>
<td>1,211</td>
<td>1,541</td>
<td>4,341</td>
</tr>
<tr>
<td>No. of Mixed Species</td>
<td>1,782</td>
<td>586</td>
<td>303</td>
<td>50</td>
<td>55</td>
<td>52</td>
<td>29</td>
<td>58</td>
<td>159</td>
</tr>
<tr>
<td>Mortality</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mortality</td>
<td>296</td>
<td>267</td>
<td>501</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Population (million)</td>
<td>15.102</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:**
2. USAID (1984), cable from AID/Colombo mission.
Figure 9-1.

Map showing annual parasite incidence by Health Areas in 1982.

Figure 9-2.

Map showing the 10 Health Areas with API greater than 10 in 1982.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM
DEPARTURES FROM TRADITIONAL STRATEGIES

According to Wickramasinghe,(6) larvivorous fish have been used in wells, tanks, and rain water collections, since the 1930s.

Intermittent flushing of a stretch of the Mahaweli Ganga below the Polgolla Dam is carried out at intervals to disrupt larval breeding.

DELIVERY SYSTEM NOW IN USE
Structure and staff

The Anti-Malaria Campaign of Sri Lanka is run as a vertical malaria control program with a highly centralized structure within the General Health Services. A Superintendent is in charge who is responsible to the Deputy Director of Public Health Services. All of the staff are unipurpose malaria workers, carrying out specific duties as required in an antimalaria program, that includes residual house spraying, surveillance, diagnosis, treatment, epidemiological and entomological study and analysis.

It should be mentioned that the AMC has as its ultimate goal the eradication of malaria but without a fixed time limit.

<table>
<thead>
<tr>
<th>Headquarters</th>
<th>Regional/Subregional Level</th>
<th>Periphery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Officers (Malarialogists)</td>
<td>Regional Medical Officers (Malarialogists)</td>
<td></td>
</tr>
<tr>
<td>Entomologists</td>
<td>Public Health Inspectors (Anti-Malaria Campaign)</td>
<td></td>
</tr>
<tr>
<td>Public Health Inspectors (Anti-Malaria Campaign)</td>
<td>Vigilance Units - Subregional Officers</td>
<td></td>
</tr>
<tr>
<td>Entomological Assistants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spraying Supervisors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACD/PCD

ACD is conducted by surveillance agents of the AMC. In March 1982, a new stratified approach towards spraying was introduced, and, also, almost 500 new surveillance agents were appointed, to improve surveillance. (There was an 18% drop in malaria in 1982 from 1981.)

PCD refers to blood slide collection in all medical institutions by non-AMC staff. Only a small number of the total slides examined and positives detected occurs through this PCD (in 1982: 23,378 slides examined, 841 positives detected). The Administration Report of the AMC reports that the recording and reporting of fever patients at Medical Institutions is unsatisfactory.
Sri Lanka also has a category called Activated Passive Case Detection (APCD). This refers to AMC staff collecting blood slides from fever/suspected patients who attend health centers and other health institutions. This is the major source of blood slides in Sri Lanka. Although the blood slides are collected at health institutions, they are examined at AMC laboratories.

**Method of Diagnosis and Coverage**

There are malaria microscopists posted in seven regional laboratories throughout the country, who only examine malaria blood slides. The vast majority of blood slides are collected through the Activated Passive Case Detection system, which refers to malaria surveillance workers collecting blood slides from patients attending the various medical institutions.

Cross checking of slides is carried out (about 40% of the positives and about 15% of the negatives was carried out in 1982).

**Drug Protocols**

Radical treatment is given to clinical and suspected malaria cases at Medical Institutions, Voluntary Treatment Centers, and by AMC staff. Blood examination is not necessarily done.

Mass Radical Treatment is given during localized epidemics of *P. falciparum*.

Presumptive treatment is administered by physicians or AMC staff in highly malarious areas and in development schemes.

Prophylactic treatment with chloroquine has been carried out in several development areas.

Mass Drug Administration with chloroquine (450mg) plus primaquine (30mg) biweekly has been used in containing localized epidemics.

Pyrimethamine was found to be very effective against *P. falciparum*, thus an effort has been made to reserve it for use when chloroquine resistance appears.

**Spray Operations (frequency/insecticides used)**

Malathion residual spraying is carried out according to a recently introduced (March 1982) stratification of the country:

- the Jaffna peninsula sprayed once a year
- the Northern dry belt twice a year
- the "hardcore areas" sprayed as usual four times a year

The quarterly spray schedule in the most malarious areas is called "perennial spraying." The less-frequent schedules are called "seasonal" spray coverage.

A large number of "seasonal laborers" were employed on a casual basis for spraying in 1982, due to it being the first year of the stratified spraying program.

ULV fogging with malathion and larviciding with temephos (Abate) are used in a few selected areas at times of religious gatherings.

Serum cholinesterase estimations are conducted of spraymen.
Figure 9-3.

Map showing spraying programs by Health Areas in 1982.

Type of Epidemiological and Entomological Data Available

Epidemiological data of fairly good detail is available in the Administration Report of the AMC. However, that report also states that data from other parts of the health system (hospitals, etc.) and private physicians is not available.

The Entomological staff of the AMC comprise about 1.1% of the AMC staff (77 out of 4,777). Entomological teams carry out a variety of entomological activities that are standard in a malaria control program, primarily to monitor the operational effectiveness of malathion spray operations (vector densities: pyrethrum spray collections, human bait collections, window trap collections, cattle bait collections, larval sampling; vector competence: precipitin tests, parous rates; insecticide susceptibility tests; bio-assay tests) and to investigate foci of transmission, but also special studies, including a study of vectorial status/competence of indigenous anopheline species in Sri Lanka.

Meteorological data (rainfall, temperature, humidity) is collected from various stations and available for analytical purposes.

Training Programs (pre-service and in-service)

An orientation program on malariology is conducted for primary health care workers: family health workers, public health supervisors, and public health nurses. This was inaugurated in 1981.

Refresher training programs in malariology for Medical Officers of Health, Assistant Medical Practitioners, Public Health Nurses, and Public Health Inspectors are given.

There are also orientation programs for Medical Officers and Public Health Inspectors.

Malaria microscopists undergo a three month training course, which is conducted several times each year.

There are also special training programs, e.g., malathion susceptibility, bio-environmental methodologies, and ULV spraying.

Refresher training courses (two weeks) are held for entomological assistants and field assistants of the AMC.

Operations Research (in-house, universities, etc.)

The Entomological Section of the AMC is engaged in a number of operational research projects: 1) vectorial status/competence of indigenous anopheline species in Sri Lanka (sponsored by the WHO/TDR program under a grant from UNDP/World Bank/WHO); 2) establishment of discriminating dosages of malathion and other candidate insecticides under field conditions for the local anopheline species; 3) cross resistance patterns in An. culicifacies; 4) bio-assay testing of malathion; 5) updating of An. culicifacies bionomics; 6) breeding habits of indigenous anophelines.

Epidemiological studies include: a study of river flow patterns as an early warning mechanism; a study of relapse patterns in P. vivax patients; chloroquine resistance testing; G-6-PD testing.
ANALYSIS OF OPERATIONAL PROBLEMS
INSECTICIDE RESISTANCE

Insecticide resistance is a major problem, because DDT resistance has necessitated the substitution of more expensive malathion, and signs of malathion resistance are now appearing. *An. culicifacies* is resistant to DDT countrywide. Tests of *An. culicifacies* have detected resistance to malathion (the current insecticide in use) in Puttalam, Kurunegala, Vavuniya, and Mannar. However, it is reported there are no control problems at field level. Still, this is a troubling prospect, because all of the next alternative insecticides are extremely expensive.

Bio-assay tests of the residual effectiveness of malathion against *An. culicifacies* have shown that where the spray is applied under close supervision, it is effective for over 3 months. However, bioassays of the same walls sprayed under operational conditions show the malathion to be effective for only one month, indicating poor quality of spraying. Coupled with the severe problem of spray refusal by the population, it must be questioned as to how effective the spray program really is.

Twelve species, additional to *An. culicifacies*, are suspected as potential vectors, and four have been detected with natural infections. Of these suspected vectors, *An. subpictus*, *An. nigerimus*, and *An. barbirostrus* are highly resistant to malathion. Other anophelines resistant to malathion are: *An. hyrcanus*, *An. annularis*, *An. varuna*, and *An. vagus*.

VECTOR BEHAVIOR

Vector behavior is a major problem in that *An. culicifacies* exploits a wide variety of breeding sites. There are no reported changes in vector behavior, such as avoidance of insecticide sprayed surfaces or exophilic behavior (these usually result from DDT use, which is not present in Sri Lanka).

SPRAY COVERAGE

Spray coverage is a major problem. There is a high refusal rate, both the active refusal, and a passive refusal of homeowners closing up their houses on the spraying day. Furthermore, the Administration Report of 1982 states that severe restrictions on fuel and travelling during peak transmission seasons have hindered the spray operations and supervision. The interval between cycles becomes extended beyond the effective residual life of the insecticide, resulting in local epidemics.

DRUG RESISTANCE

Drug resistance is not a reported problem in Sri Lanka. There is no reported resistance to chloroquine or Fansidar. Limited in vitro testing has been carried out.

Radical treatment of all malaria cases is supposed to run five days, however, only the first day's treatment is normally administered by malaria staff. Thus there is a question of whether treatment is completed by the patient at home.
Table 9-4. Spray Coverage in Control Areas

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Percent coverage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perennial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fully sprayed</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>62.5%</td>
<td>59.0%</td>
<td>57.0%</td>
<td>57.0%</td>
</tr>
<tr>
<td>partially</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23.5%</td>
<td>25.0%</td>
<td>25.0%</td>
<td>24.0%</td>
</tr>
<tr>
<td>Seasonal¹</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fully sprayed</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>63.0%</td>
<td>63.0%</td>
<td></td>
</tr>
<tr>
<td>partially</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23.0%</td>
<td>21.0%</td>
<td></td>
</tr>
</tbody>
</table>


¹ Started in 1982.
QUALITY OF DIAGNOSTIC WORK

The number of malaria microscopists posted throughout the country, who only examine malaria blood slides, is below needs. In the past two years, over 1 million blood slides were collected, resulting in a severe backlog of unexamined slides. The vast majority of blood slides are collected through the Activated Passive Case Detection system, which is malaria surveillance workers collecting blood slides from patients attending the various medical institutions. When backlogs develop, the slides are redirected to less-burdened laboratories, resulting in further delay and loss. Because examination is not timely, surveillance, followup, and remedial action are not effectively implemented.

It is reported that clearance of the backlog of slides from 1982 was only finalized three months into 1983.

Cross checking of slides in 1982: 42.4% of positives and 14.5% of negatives. Of the positives checked, 2.5% were in error (354 false positives); of the negatives checked, 0.2% were in error (394 false negatives).

QUALITY OF ENTOMOLOGICAL DATA

This appears to be good. There is a full agenda of studies in progress. The AMC entomology section is led by a fully qualified entomologist.

QUALITY OF EPIDEMIOLOGICAL DATA

The amount and quality of data appears to be good, perhaps better than many other countries in the region. As in many countries, epidemiological data on malaria is collected by the malaria program, and separately by the general health service. Consequently there is a discrepancy in malaria mortality data.

QUALITY OF TRAINING PROGRAMS

No information available.

OTHER PROBLEMS

Gem mining is carried out by individuals in the forest. It is believed that the 1967 epidemic was fueled in part by a large gem find that attracted a large number of non-immune people into the transmission areas and who then spread malaria back to their home communities. Gem mining continues resulting in the creation of numerous potential breeding sites. A related concern of the AMC (which may be remote) is that large numbers of Thai nationals come to Sri Lanka to purchase gems, and it is feared that drug resistant malaria may be imported.

Non-immune and semi-immune people are settled in development areas where malaria transmission is prevalent. Not only are these people at risk, but their custom of returning to their home communities when sick raises the risk of introduction and spread of malaria to non-prevalent areas.

A large number of vacancies exist in the cadre of Microscopists, Regional Medical Officers, and the approved posts of Parasitologist and Entomologist. There is also a continuing delay in the supply of sprayers, spare parts, printed forms, and other vital supplies.
There is some concern that the security situation in Sri Lanka will greatly circumscribe AMC activities.

The Administration Report of 1982 lists the following problems:

1. "Large number of vacancies in microscopists cadre"
2. In 1982, although PV substantially down from 1981, PF were up "new areas such as Vavuniya and Anuradhapura are responsible for the increased PF cases [and] is a matter of grave concern."
3. "Lack of supervision and interest of anti-malaria activities both at the periphery and at Headquarters is the primary cause of this flare-up in these areas."

"It is regretted that the Northern and Eastern regions have hardly been supervised by Headquarters staff. This has been now corrected, where the S/AMC has taken the responsibility of directing officers and supervising their itinerary."

"Further the S/AMC and the Entomologist have been spending most of their time in answering malicious, frivolous and false accusations made by members of the headquarters staff and of the press in particular. This led to an inquiry being conducted into the problems of the Headquarters staff. The smooth working of the headquarters staff is a sine qua non for better discipline down the line."

4. "the very restricted quota of fuel in most cases restricted supervision to just a week in a month and the apathy of the community towards Anti-Malaria activities were also contributory factors."
5. Medical institutions do not maintain correct statistics nor report (to AMC) high incidence of fever (the first screen) at the OPD.

PROGRAM FINANCING

The total budget allocation for the AMC in 1982 was Rs.123,508,000, which was 9.9% of the total Health Budget.

Table 9-5.
MCP Program Financing

<table>
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<tr>
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</thead>
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<td>Host Government</td>
<td>$2,055,136</td>
<td>$2,034,097</td>
<td>$2,417,846</td>
<td>$2,207,598</td>
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<td>WHO</td>
<td>226,728</td>
<td>232,271</td>
<td>239,001</td>
<td>237,783</td>
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<tr>
<td>AID</td>
<td>2,318,569</td>
<td>2,433,090</td>
<td>3,150,012</td>
<td>2,876,098</td>
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<td>Netherlands</td>
<td>86,964</td>
<td>128,030</td>
<td>38,361</td>
<td>25,025</td>
</tr>
<tr>
<td>U. K.</td>
<td>64,345</td>
<td>1,266</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>$4,751,742</td>
<td>$4,828,755</td>
<td>$5,845,220</td>
<td>$5,356,504</td>
</tr>
</tbody>
</table>

In U. S. dollars

STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS

The Administration Report of 1982 states that the entomological work has an inadequacy of trained manpower, lack/shortage of some basic supplies and equipment.

Malathion insecticide has been financed by AID loans and Government of Netherlands grants during the past several years.

POTENTIAL NEEDS FOR AID ASSISTANCE

There seems to be an active program of entomological research in Sri Lanka, for which AID has recently funded construction of an insectory. One important project is the investigation of the vector status of anophelines other than An. culicifacies. This is a question that has been extremely difficult to study not only in Sri Lanka, but all malarious areas of the world, due to the tedious unproductive methods previously available (salivary gland dissection). Recently, a new immunological method for the incrimination of malaria vectors using monoclonal antibodies in a radioimmunoassay has been described and field-tested (in Africa and Thailand). It is reported that the current study is meant to use this technique, but arrangements have been delayed. If this method is not being employed by the Sri Lankan research project, it might be possible for AID to introduce or support the method through sponsorship of a training fellowship or provision of a technical consultant.

The Sarvodaya Project is a popular mass movement in Sri Lanka that is led by a charismatic local figure. The movement is built around community organization and self-help. One activity that the movement has taken up is community participation in antimalaria measures, especially anti-larval measures such as draining and filling, larviciding, or just fouling of the breeding sites (An. culicifacies prefers fresh, clean water). It may be possible that AID could promote this project by provision of support.

Training - short-term consultants in-country and/or overseas training experiences
- entomological
- management - supply, program planning
- technical
  - in vitro/in vivo test techniques,
  - vector control techniques,
  - computerization of data
- training of trainers for health education

Operational Research
- new insecticides
- larvicides
- data management systems to implement epidemiological approach to malaria control
- operational programming - stratification, different techniques

Limited commodity support
Evaluation - donor coordination

Technical Assistance
- entomological techniques
- operational management
- laboratory and field diagnosis techniques
- surveillance/epidemiology
- health education
BIBLIOGRAPHY - SRI LANKA


5. USAID (1984), cable from AID/Colombo mission.


THAILAND

OVERVIEW OF THE NATURE AND MAGNITUDE OF THE PROBLEM

INTRODUCTION

Malaria in Thailand is a major problem due to the number of people at risk, the large incidence, and the worst multi-drug resistance problem in the world. Although success was achieved in greatly reducing malaria transmission in the central plains, transmission remains high in the forested and hilly areas where the principal vector An. dirus is well-characterized for its strong exophilic and exophagic behavior, as well as an excito-repellant behavior to DDT, which all combine to make intervention against it problematic. This vector is now recognized as part of a species complex formerly known as An. balabacensis s.l. The exact vector status of all the sibling species is still under investigation. The other principal vector An. minimus (breeding in the vegetated edge of irrigation ditches and slow-moving streams) has become very rare in the central plains, but remains an important vector transmitting malaria in the hills and forests (with An. dirus). It has become exophilic and thus unresponsive to residual intradomiciliary insecticiding. There are three secondary vectors: An. maculatus in the forested hills of southern Thailand, An. sundaicus (breeding in brackish pools) in coastal areas, and An. aconicus in a few localized areas.

The falciparum strains in Thailand are completely resistant to chloroquine, virtually resistant to sulfadoxine-pyrimethamine, and even show some resistance to quinine. Mefloquine is in the final stages of clinical trials and will be introduced for general use in 1985.

Major population movement, especially economic migration (e.g., agricultural workers and gem miners), is common and large-scale. This leads to rapid spread of drug-resistant parasite strains and greatly complicates diagnosis, treatment, and follow-up.

HISTORY OF ANTIMALARIA ACTIVITY

Antimalaria activities date back to 1930, when malaria control units were established. In 1943, the Division of Malaria and Filariasis Control, Dept. of Health, Ministry of Public Health was formed. Measures taken included quinine distribution, limited antilarval measures, and public education on personal protection.

From 1949-51, a malaria control demonstration team carried out a trial of DDT residual spraying with WHO and UNICEF assistance. From 1951-55, an expanded malaria control program with US assistance (ECH, FOA, and ICA) brought 6 million population under DDT spraying and completely interrupted transmission in the plains by the disappearance of An. minimus. In 1956, the program became a malaria eradication campaign to cover 12 million population, which was expanded over the next four years.

During the period 1961-65, a new assessment was conducted and the Division of Malaria and Filariasis was changed to the National Malaria Eradication Program/Project, with assistance from WHO and USAID. By 1965, antimalaria measures essentially eliminated malaria in areas where 80% of the population lived.
In 1968, USAID began phasing out support and ended all financial and material support in 1970. (The reasons for this move are not known.) In 1971, as a result of the budget reductions and as a result of the revised WHO malaria control strategy, a new policy and plan of operations was formulated to maintain the reductions in incidence within lower spending. This was not achieved. Malaria rose due to several serious problems. In 1974-75, an external assessment and a Ministry of Public Health country health plan developed a new plan of operations for malaria, covering the entire population, that was implemented in 1978. The program essentially stratifies the country into two strategies:

1) areas where malaria is endemic and regular residual spraying will be carried out indefinitely (malaria control), and

2) areas where malaria has been greatly reduced allowing the progression into consolidation and maintenance phases of surveillance (malaria eradication). Where malaria is greatly reduced, full surveillance is planned to be taken over by the Provincial Health Services (partial and full integration).

In 1980, USAID provided funding for a four-year project of development and strengthening of malaria interventions, specifically in outreach capacity (to increase diagnosis and treatment), as well as more effective DDT spraying and better health education.

SCOPE OF MALARIA PROBLEM SINCE 1975

Morbidity

In the WHO Statistics Annual, (35) malaria is ranked first in annual incidence for all infectious diseases in 1980 and 1981. More current rankings were not available.

Following the reduction of budget support in the early 1970s and the rapid spread of drug resistant P. falciparum, malaria incidence rose in Thailand from less than 100,000 confirmed cases in 1970, to 473,000 confirmed cases in 1981 (API 10.6). However, incidence dropped significantly in 1982, and then again dramatically in 1983 (243,906 cases; API 5.2). Two reasons are believed responsible: 1) early detection and prompt treatment of malaria cases by malaria clinic staff and village voluntary collaborators both of whose numbers have been dramatically increased, and 2) new antimalarial treatment regimens.

Mortality

Mortality due to malaria has been reduced in Thailand as a whole, but still ranks high. In 1947, malaria was the leading cause of death (297.1 per 100,000 pop.). In 1975, malaria was ranked eighth (14.4 per 100,000 pop.); in 1978, the rate was 9.7 per 100,000 pop.; in 1981, malaria was ranked seventh (8.6 deaths per 100,000); while the latest available information for 1982 is 7.8 per 100,000. (16) The current malaria control program has a target of reducing mortality to less than 8 deaths per 100,000 population. Mortality due to malaria remains a serious risk in transmission areas due to the current status of widespread multidrug resistant strains of P. falciparum. It is the most prevalent species and resistant to most commonly available antimalarials, except an extend course (7 days) of quinine-tetracycline or the newest antimalarial mefloquine. Serious incidence of complicated malaria (such as cerebral malaria) is frequently encountered in Thailand. (9), (30) A research project on the physiology and treatment of cerebral malaria has been on-going in Chanthaburi Province Hospital. (33)
### Table 10-1

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Positives</th>
<th>Total Positives</th>
<th>No. of Blood Films</th>
<th>SPR (permille)</th>
<th>API (slides/100 pop)</th>
<th>ABER (slides/100 pop)</th>
<th>P.f.</th>
<th>No. of P.f.</th>
<th>Pop. Covered (million)</th>
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<td>267,534</td>
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<td>7.43</td>
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<td>95,148</td>
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<td>40.948</td>
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<td>1976</td>
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<td>282,968</td>
<td>3,600,475</td>
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<td>7.24</td>
<td>56.40%</td>
<td>124,051</td>
<td>39.743</td>
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<td>1977</td>
<td>315,431</td>
<td>310,237</td>
<td>3,973,513</td>
<td>7.94%</td>
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<td>51.73%</td>
<td>146,088</td>
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<td>1978</td>
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<td>329,532</td>
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<td>396,705</td>
<td>4,850,000</td>
<td>8.1%</td>
<td>8.9</td>
<td>68.54%</td>
<td>123,046</td>
<td>44.2</td>
<td>44.8</td>
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<td>1981</td>
<td>473,210</td>
<td>477,922</td>
<td>5,580,000</td>
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<td>10.6</td>
<td>68.90%</td>
<td>145,423</td>
<td>46.0</td>
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<td>1982</td>
<td>420,799</td>
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<td>6,090,000</td>
<td>7.0%</td>
<td>-</td>
<td>68.53%</td>
<td>131,011</td>
<td>46.9</td>
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<td>1983</td>
<td>243,906</td>
<td>-</td>
<td>5,360,000</td>
<td>4.5%</td>
<td>-</td>
<td>65.31%</td>
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</table>

USAID (1984), cable from AID/Bangkok mission.
Figure 9-1.

Fig. 8—Areas of control, consolidation, and partial integration of the National Malaria Control Programme, Thailand.

REVIEW OF CURRENT STRATEGY AND TACTICS OF ANTI-MALARIA PROGRAM

DEPARTURES FROM TRADITIONAL STRATEGIES

A remarkable decrease in malaria cases beginning in 1982, and rapidly declining in 1983, is attributed largely to a greatly intensified identification and treatment program which has received substantial support under the USAID anti-malaria project. This program now has over 450 malaria clinics and 30,000 village voluntary collaborators throughout the country. The large increase of clinics with diagnostic capability have decentralized and expedited slide examination and case treatment.

DELIVERY SYSTEM NOW IN USE

Structure and staff

The national anti-malaria strategy has divided the country into areas where eradication strategy seems feasible (central plains) and areas where anti-malaria interventions will continue for the long-term due to limited effect (the forested and hilly areas of the country where malaria is endemic). The National Malaria Control Program functions as a vertical division in the Ministry of Public Health. Where malaria transmission has disappeared, the general health service has taken over surveillance (i.e., blood slide submission and presumptive treatment).

The Malaria Division has divided Thailand into four types of operational areas:

Full Integration Area: covering Bangkok Metropolitan area and the ten surrounding provinces with about 18% of the country's population (84 million of the total 47 million). This area may be considered non-malarious. Surveillance is under the general health service.

Partial Integration Area: covering most of the plain areas located in every region, with about 57% of the population of the country. Malaria incidence in this area is very low, and malaria activities are partially integrated into the general public health services. FCD and malaria clinics are available.

Consolidation Area: covering a small part of the country distributed in every region, with a population of about 2%. Full surveillance is carried out by malaria personnel.

Control Area: corresponds to the area bordering Burma, Laos, Kampuchea, and Malaysia, plus the mountain ranges crossing Central Thailand from north to southeast, with a population representing about 23% of the country. About 66% of the population in control areas are living in areas where spraying has been withdrawn.

ACD/PCD

ACD is carried out in the Consolidation areas where the Malaria Division is responsible for surveillance, radical treatment, case investigation, and follow-up. In a few areas under regular spraying (malaria Control Areas), Special Case Detection (SCD) is carried out, which includes mass blood surveys and case investigations (criteria of selection are not known).
PCD is provided throughout the country by PCD posts staffed by Malaria Division staff at sector and zone offices, and by village voluntary collaborators. Malaria clinics with microscopists exist at region, zone, and sector offices and at some hospitals and health centers, and have been established as well in certain villages with high endemicity. In areas under partial integration in the Provincial Health Services, only PCD is provided.

Method of Diagnosis and Coverage
Malaria cases are confirmed by microscopic diagnosis carried out by Malaria Division staff.

Drug Protocols
Radical treatment of *P. falciparum* is due for revision from January 1985. The new regimen will be a combination of sulfadoxine, pyrimethamine, mefloquine (to be marketed as Fancimef), and primaquine. This regimen has been in use in the Cambodian border area, the southeastern districts (Chanthaburi, Trad, Rejong, Cholburi), and eastern districts with Burmese refugees.

During 1984, the following regimens were also in use:

- Radical treatment of *P. falciparum* in areas still sensitive to sulfadoxine-pyrimethamine: Fansidar, or equivalent, two tablets (sulfadoxine 1000mg, pyrimethamine 50mg) plus primaquine (15mg daily, x5 days).
- Radical treatment of *P. falciparum* in areas less sensitive to sulfadoxine-pyrimethamine: Fansidar, or equivalent, three tablets (sulfadoxine 1500mg, pyrimethamine 75mg) plus primaquine (15mg daily, x5 days).
- Radical treatment of *P. falciparum* in areas resistant to sulfadoxine-pyrimethamine: quinine (600mg, t.i.d., x3 days) plus tetracycline (250mg, q.i.d., x7 days) plus primaquine (15mg, x5 days). For children under 9 years, tetracycline is not given.

Radical treatment of *P. vivax* is chloroquine (1.5g divided over three days, with a loading dose on day one) plus primaquine (15mg daily, x14 days).

Two different presumptive treatments have been in use: a single dose of sulfadoxine-pyrimethamine (Fansidar, or equivalent, 2 tablets) plus primaquine (30mg); or a two-dose regimen of chloroquine (300mg) plus primaquine (15mg) on each of two days. Presumptive treatment may be modified with the introduction of mefloquine.

Spray Operations (frequency/insecticides used)
Residual house spraying of DDT (2 g/m²) twice annually is carried out in the hilly, wooded, and foothill areas of Thailand where the vector species *An. dirus* [= *An. balabacensis* s.l.], *An. minimus*, and/or *An. maculatus* transmit malaria. These areas are classified as "malaria control areas."

In some limited areas classified as under "malaria eradication," DDT spraying is also carried out in a "late attack phase."

Fenitrothion has been used since 1982 in some villages bordering Kampuchea, Laos, and Burma, for residual spraying. In limited areas, thermal fogging with malathion or fenitrothion is used in response to focal outbreaks.
Type of Epidemiological and Entomological Data Available

Entomological data collections include: longitudinal observations in selected fixed index villages to assess anti-vector measures; spot checks in areas without regular entomological work; vector susceptibility is monitored; focal investigations are carried out when transmission is detected in eradication areas.

Training Programs (pre-service and in-service)

The Health Education and Training Section coordinates training courses for all categories of Malaria Division personnel, both pre-service and in-service. Training courses have also been carried out for general health service personnel as part of the integration process.

The Training of Trainers Program is reported to be successful. This workshop is slated to be implemented throughout Thailand, and possibly adapted for other countries in the region.

Regular pre-service training courses are conducted at the National Malaria Training Center at Phraphutthabat. (For example, two-month course for microscopists; two-month course for Sector Chiefs, plus 12 months at other sites for general health and sanitation instruction). In-service training is also included. Technical training courses, seminars and workshops have been held to meet specific needs of the program, such as in vitro drug testing, problems and their solutions.

Training is also conducted by the Regions, Units, and Sectors themselves, especially for the malaria volunteers and other peripheral personnel.

Public information activities conducted by the Malaria Division include: public exhibitions; radio, television and newspaper coverage; posters, leaflets, pamphlets and plastic school bags; flip charts and flannel cutouts for school presentations; mobile public address systems during spray operations; movie shows.

Operations Research (in-house, universities, etc.)

An Applied Field Research Section in the Malaria Division was formed in 1979, headed by a PhD graduate in medical entomology.

The Malaria Division is currently carrying out an active research program, such as, studies on parasite sensitivity and resistance to various drug regimens, immunofluorescent antibody testing, effects of different levels of insecticide pressure on vectors, and biological control of mosquito larvae.

Because of the serious drug resistance problem, Thailand has functioned as a site of numerous investigations into the phenomenon and alternative treatment regimens to counteract it. These have been conducted by the Malaria Division in collaboration with WHO, Mahidol University, the Armed Forces Research Institute for Medical Science (AFRIMS/Bangkok).

AFRIMS (formerly known as the SEATO Laboratory) has been especially active in entomological investigations since 1961.

USAID provided funds during the past four years for construction of laboratory and research buildings at Malaria Division Headquarters and five other locations.
The number and range of projects underway by the Malaria Division and other institutions is large and varied. There have been a number of nationwide malaria research meetings to coordinate this work.

ANALYSIS OF OPERATIONAL PROBLEMS

INSECTICIDE RESISTANCE

Insecticide resistance is not a problem. There is no reported vector resistance to DDT, probably because of exophilic behaviour of vector species. There is some tolerance to DDT in limited areas with An. minimus, An. dirus, and An. maculatus.

VECTOR BEHAVIOR

Vector behavior is a major problem. An. minimus has shifted from indoor to outdoor biting and resting. An. dirus rests outdoors, especially where DDT residual spraying is used.

The breeding sites of An. dirus are not amenable to antilarval measures. This vector also exploits a variety of man-made breeding sites in the forest that result from economic activities. Gem mining in the southeastern region of Thailand has resulted in large numbers of pits left to fill with rainwater that support extensive An. dirus breeding.

Steps taken to address this problem include the promotion of personal protection measures and studies on bio-environmental measures, such as the use of larvivorous fish and Bacillus thuringiensis. Specific studies on An. minimus and An. maculatus are underway.

SPRAY COVERAGE

Spray coverage is a major problem. After decades of intradomiciliary DDT spraying, high refusal rates by house owners are common. Although complete spray coverage has risen in the past few years, it is still too low to be very effective (66% of targeted houses in 1983). The refusals include active refusal (either for the house as a whole, or for certain areas of the house) and passive refusal (leaving the house locked on day of spraying).

Some progress has been noted in areas where health education has been strengthened. Also, in areas where fenitrothion was used, a significant increase in spray coverage was reported initially, due to the effect on nuisance insects whose reduction is greatly appreciated by house owners(32) and heightened supervision for this new tactic. More recent information suggests that spray coverage in fenitrothion areas may be slipping as supervision relaxes back to normal and villagers become dissatisfied with the odor.(6)
### Table 10-2. Spray Coverage

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<tr>
<td>Total Houses</td>
<td>1,014,817</td>
<td>1,084,517</td>
<td>1,030,835</td>
<td>1,116,254</td>
<td>793,285</td>
<td>711,478</td>
<td>764,161</td>
<td>792,118</td>
<td>717,367</td>
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<tr>
<td>Percent sprayed (completely sprayed)</td>
<td>44.97%</td>
<td>41.25%</td>
<td>40.25%</td>
<td>42.93%</td>
<td>49.69%</td>
<td>58.4%</td>
<td>59.9%</td>
<td>64.0%</td>
<td>64.9%</td>
</tr>
<tr>
<td>Percent sprayed (incompletely sprayed)</td>
<td>43.03%</td>
<td>46.57%</td>
<td>48.45%</td>
<td>46.36%</td>
<td>40.73%</td>
<td>32.8%</td>
<td>31.3%</td>
<td>28.8%</td>
<td>27.1%</td>
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<tr>
<td>Percent unsprayed</td>
<td>12.00%</td>
<td>12.18%</td>
<td>11.30%</td>
<td>10.72%</td>
<td>9.58%</td>
<td>8.8%</td>
<td>8.8%</td>
<td>7.2%</td>
<td>7.9%</td>
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<tr>
<td>Total Farmhuts sprayed</td>
<td>232,158</td>
<td>258,893</td>
<td>231,168</td>
<td>206,449</td>
<td>269,016</td>
<td>284,092</td>
<td>351,448</td>
<td>373,564</td>
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<td>Pop. in sprayed houses (million)</td>
<td>5.221</td>
<td>5.595</td>
<td>5.294</td>
<td>5.030</td>
<td>3.497</td>
<td>3.20</td>
<td>3.42</td>
<td>3.54</td>
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<tr>
<td>Total Houses</td>
<td>440,862</td>
<td>374,800</td>
<td>434,106</td>
<td>441,974</td>
<td>416,717</td>
<td>370,364</td>
<td>395,585</td>
<td>476,442</td>
<td>397,142</td>
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<tr>
<td>Percent sprayed (completely sprayed)</td>
<td>45.44%</td>
<td>45.67%</td>
<td>44.00%</td>
<td>50.05%</td>
<td>54.76%</td>
<td>62.1%</td>
<td>61.7%</td>
<td>71.3%</td>
<td>67.6%</td>
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<tr>
<td>Percent sprayed (incompletely sprayed)</td>
<td>42.89%</td>
<td>44.17%</td>
<td>45.75%</td>
<td>40.47%</td>
<td>36.16%</td>
<td>30.7%</td>
<td>31.7%</td>
<td>21.4%</td>
<td>25.6%</td>
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<tr>
<td>Percent unsprayed</td>
<td>11.67%</td>
<td>10.16%</td>
<td>10.25%</td>
<td>9.48%</td>
<td>9.08%</td>
<td>7.2%</td>
<td>6.4%</td>
<td>7.3%</td>
<td>6.7%</td>
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<tr>
<td>Total Farmhuts sprayed</td>
<td>114,901</td>
<td>203,207</td>
<td>151,509</td>
<td>206,449</td>
<td>194,318</td>
<td>250,567</td>
<td>279,660</td>
<td>276,802</td>
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<td>Pop. in sprayed houses (million)</td>
<td>2.201</td>
<td>1.893</td>
<td>2.150</td>
<td>1.949</td>
<td>1.846</td>
<td>1.67</td>
<td>1.81</td>
<td>2.11</td>
<td>1.85</td>
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</tbody>
</table>

*Note: Decrease in spray coverage for 1983 (cycle 2) due to temporary shortage of Insecticide.*

**Source:**
USAID (1984), cable from AID/Bangkok mission.
DRUG RESISTANCE

Drug resistance is a major problem. Thailand was one of the first countries in which chloroquine resistance was detected in the early 1960s. P. falciparum resistance to chloroquine is virtually 100% in Thailand. Resistance to sulfadoxine-pyrimethamine (Fansidar) is widespread. Quinine resistance has also been detected. The only widely available effective drug treatment has been quinine plus tetracycline. Mefloquine in combination with sulfadoxine and pyrimethamine is undergoing widespread field trials, and is being rushed through these clinical trials. This triple-drug combination (marketed as "Fansimef") is expected to be available in 1985 as a single dose P. falciparum radical treatment regimen countrywide. Although the use of the triple-drug combination is hoped will delay the development of resistance (based on murine research by Peters in the 1970s(21)), it is a controversial tactic. Even if effective, the key word is delay of resistance. A case of mefloquine resistance has already been reported in Thailand.(1) Malaria chemotherapy will remain a pressing research need.

Although chloroquine is not useful against P. falciparum, it is still effective against P. vivax and P. malariae.

QUALITY OF DIAGNOSTIC WORK

Diagnostic work is good. Error rates have been found quite low (false negatives <1%; false positives <0.5%). Checking of slides is carried out.

QUALITY OF ENTOMOLOGICAL DATA

A recent report indicates that the entomological monitoring activities are carried out, but lack adequate supervision by Unit Chiefs, and are not always carried out on schedule, that vector susceptibility tests are not sufficient in number.(32)

QUALITY OF EPIDEMIOLOGICAL DATA

Epidemiological data in the program is as good as most anti-malaria programs derived from the WHO eradication model, which is to say statistics on slides examined and diagnosis are available, but not always in a timely fashion for quick response. While the structure is present, it needs to be upgraded, strengthened, improved.

Inadequate surveillance activities by the general health services is reported as a problem.

Asymptomatic malaria is prevalent in the rural areas where residents become semi-immune under repeated inoculation. This leads to underreporting of the true prevalence. These undetected cases represent a significant parasite reservoir. Mass blood surveys can resolve this, but clear objectives and planning are needed.

QUALITY OF TRAINING PROGRAMS

Training programs were one emphasis of the recent AID assistance project. A recent evaluation reported that the various course curricula and schedules were comprehensive, and that trainees have given good reports on the content.(32)
OTHER PROBLEMS

Population movements are a serious problem in Thailand, because people frequently migrate countrywide in search of employment, as well as more local movement from village to forest and back. At various seasons, large numbers of people become migrant farm laborers, (small farm owners as well as landless). Fruit orchards have become important transmission sites. Gem mining in southeast Thailand and across the Cambodian border draws people (many non-immune) from all parts of Thailand, who then redisperse spreading drug-resistant malaria throughout Thailand. Detection and follow-up in the face of this massive internal migration is a significant technical problem.

The Kampuchean refugees, by their movement across the border, have a severe malaria problem, but the role in malaria transmission within Thailand has diminished. Far more significant is the movement of Thais across the border into Cambodia, and of Thais and Burmese across the Burmese border.

Security problems in several border areas, notably the southern peninsula, have hampered effective antimalaria measures in the recent past. The situation is currently stable.

- Insufficient funds and material resources.
- Inadequate qualified and experienced manpower.
- Delays in reporting.

PROGRAM FINANCING

The Government of Thailand has increased yearly the budget authorization for antimalaria activities, but still not matching the rate of inflation.
Table 10-3. MCP Program Financing

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<td>Host Govt. (US$000)</td>
<td>5,523</td>
<td>6,857</td>
<td>7,132</td>
<td>7,730</td>
<td>8,078</td>
<td>8,535</td>
<td>9,203</td>
<td>9,476</td>
<td>10,696</td>
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<tr>
<td>% of Health Budget</td>
<td>7.6%</td>
<td>5.8%</td>
<td>4.2%</td>
<td>4.5%</td>
<td>4.3%</td>
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<td>WHO</td>
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<td>AID</td>
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<td>480</td>
<td>1,668</td>
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<td>ESF (AID)</td>
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<td>Govt. of Japan1</td>
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<td>3,500</td>
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<td>Total</td>
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<td>7,053</td>
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<td>8,301</td>
<td>8,232</td>
<td>10,346</td>
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In thousand U.S. dollars
(Host Govt. - Baht mil.) (117.0) (137.2) (142.4) (154.5) (167.4) (173.3) (188.6) (217.9) (246.2)

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1 Grants provided by Government of Japan for Anti-Malaria Operations Program for Kampuchean displaced persons and affected Thai people in the Kampuchean-Laos-Thailand Border areas.
STRATEGY OVERVIEW FOR AID ACTION

UNMET NEEDS
Thailand has the most active research agenda in the region. There are several research institutions (universities and AFRIMS) with trained researchers, in addition to the NMCP itself. AFRIMS is quite well endowed, AID is already supporting research at the NMCP, but researchers at the universities might need support and encouragement, such as travel fellowships, equipment, supplies. Money spent on operational research would not be wasted, but opportunities to support the university researchers might encourage innovation and wider objectivity.

POTENTIAL NEEDS FOR AID ASSISTANCE
A recent paper has reported an epidemiologic surveillance system for early detection of malaria epidemics based on the method of computing moving averages of incidence. This method is an archetype of the responsive epidemiologic analysis that is essential to the current strategy of selective malaria control, based on and tailored to local epidemiologic situations.

Support to Village Volunteers should be maintained and expanded in orderly fashion
- training has been adequate, and important
- further support could focus on modest rewards and incentives, such as provision of new equipment, health education aids, and frequent resupply of good quality materials.

Support for training trainers through the Kuala Lumpur Secretariat
Continue inputs in support of the National Training Center at Prabuddhabhat
- transport repair facility
- buses
- equipment and supplies

Extend training for senior staff
- observation tours, if these can be controlled to assure usefulness
- intersectoral exchanges (e.g., CDC, NIH) for researchers who have demonstrated ability to profit from such exchange

Technical Assistance for specialized research needs
- entomology using the latest immunological and biochemical techniques
- drug therapy trials
- rapid serological diagnostic techniques
- possible site for early vaccine trials
- health education and training

Operational research
- computerization of data collection and analysis
development of epidemic warning system
- larvicides, insecticides
- biological control
BIBLIOGRAPHY - THAILAND


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The author would like to express his appreciation for the comments, help, and advice of the following people. However, these individuals have neither reviewed nor approved the final memorandum. The author takes full responsibility.

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Richard Kalina
David Oot
Ronald Rosenberg
Edgar A. Smith
Thomas Strickland
McWilson Warren
Thomas Weller
COMMODITY SUPPORT FOR SPRAYING

In carefully describing the current antimalaria activities of these nine countries, it has necessarily happened that insecticide spraying is emphasized, because indoor residual insecticiding is the principal tactic used in most of these countries. Spraying operations are big and expensive.

There is no doubt that insecticiding has had an impact on malaria transmission over the years, and that it still can in many places. Under the theoretical model that validated the global eradication campaign, residual spraying was the correct tactic to employ, because theory showed that spraying would reduce vector longevity causing the basic reproductive rate to fall and thus lead to an eradication end-point in a relatively short time. Lacking such a near-term end-point in today’s control era, an important question now involves what time-frame to use to evaluate the benefits of intensive spray programs.

One important decision of aid involves commodity support. Several of these countries currently require commodity support provided by external donors in order to carry out spraying programs (Nepal, Bangladesh, Sri Lanka, Pakistan). Provision of such assistance initiates a dependency that should be carefully and honestly considered.

1) Residual intradomiciliary spraying is currently termed a "control" tactic to be used 1-4 times annually for an indeterminate period into the future. If the country cannot afford the chemical now, and regular use for many years into the future is anticipated, a commitment to supply insecticide should be considered realistically. During the eradication era, a satisfactory end-point was anticipated. The adoption of control strategy, inter alia, is the abandonment of time-limited eradication and of any defined end-point. If the vector is biologically susceptible, intensive insecticiding reduces malaria transmission, but relaxation of that pressure results in dramatic resurgence of malaria.

2) Malathion use (which requires external aid in most instances, due to expense) is only introduced after selection for DDT and dieldrin/BHC resistance. The historical record indicates that, if selection for DDT resistance has occurred, then the likelihood of malathion resistance appearing, followed by resistance to the next substitute, should be considered a certainty. This decision to "use up" available resources should be honestly evaluated, because it has serious implications regarding the ability to later respond to epidemic outbreaks.

3) Thus where insecticide can only be used through donor aid, careful thought should be given to limiting such use for emergency epidemics only, rather than putting a country in a dependent position that could be compromised by abrupt cessation of insecticide supply. Analysis of assistance should consider the possibility that not spraying regularly is the correct choice. This is entirely consistent with the concept of the Tactical Variants: Variants 1 and 2 make no mention of residual spraying; Variant 3 mentions insecticiding as only one of many options to be considered in a comprehensive evaluation.
4) A question arises as to whether commodity assistance should be cut off from recipients currently receiving it, and concern will be raised about such a move. That is precisely the point: a) external aid always ends eventually, and b) once a donor-cum-recipient get on board the spraying train, how do they get off?

5) Where DDT resistance has not emerged in spite of intensive long term use (e.g., in the range of An. balabacensis s.l.), behavioral avoidance by the vector is undoubtedly a factor. DDT may well be effective, not as an insecticide, but as a repellent that disturbs man-vector contact. But in that case, operational research should investigate better repellent alternatives.

6) Strong human resistance against house spraying is now highly prevalent in all areas that have experienced multiple cycles of DDT spraying, so strong as to seriously compromise the effectiveness of the spray programs in all of these countries. It is no exaggeration to say that intradomiciliary spraying in many areas is only pro forma. Health education may be a remedy to spray refusal, but there is two to three decades' perceived ineffectiveness to counteract. Where a new insecticide is introduced, the reception is initially favorable, because a benefit is perceived (household pests are readily susceptible). The point is that a frank and candid appraisal of DDT spraying in a locality may determine that the huge expense might better be spent on education and materials for alternative tactics.

PRIORITIES OF ASSISTANCE

A different decision involves which countries and which areas of a country to aid. Of course, this decision will be made considering several different perspectives, including non-technical ones, such as political factors and standing policies of the agency. One contrast that may be worth considering is that between degree of need and probability of successful implementation. Should assistance be automatically extended to those countries and areas with the highest rates of morbidity and mortality, or should probability of successful implementation carry more weight? All of these countries have had several decades of experience with antimalaria interventions. Those areas showing intractable malaria transmission may not be best choices for further action at this time. Those countries and areas that have responded to antimalaria interventions may be the most appropriate ones for further assistance, especially if the pool of assistance is limited. Where problems are greatest, solutions may be most elusive. Obviously this raises a philosophical decision to be made -- pursue pragmatic likely success, or stimulate and search for possibly nonexistent answers. The solution is not obvious, and this decision really needs the advice of perceptive in-country experts, but most of these countries have already dealt with this question. Under control strategy, remote, sparsely populated areas without economic importance are left out of any active antimalaria tactics.
TWO OPTIONS FOR AID ACTION

OPTION 1

A significant part of operational antimalaria programs is collection and tabulation of routine statistics. All programs went through an eradication period, during which a system of reporting epidemiologic data, spray statistics, and entomologic data was put in place. In most programs, essential particulars of suspected malaria cases (name, address, age, sex, date of slide collection, and diagnosis) are recorded in a log book or equivalent. Spraying statistics are similarly recorded. PLEASE NOTE: A rich source of epidemiologic data is already being collected by most antimalaria programs.

From this primary data collection, all further statistical reporting of the program is then derived (e.g., number of slides examined and number of cases detected, number of houses sprayed/unsprayed, on a weekly, monthly, quarterly, and annual basis). However, much of the information (such as address, age, sex) is not fully used epidemiologically.

In the eradication period, this body of statistics was collected to note the march of progress of the project. In the control era, these statistics should have greatly increased importance, because every control program pays lip service to a selective application of antimalaria interventions based on and tailored to the epidemiological situation in defined localities. However, the reality is that the numbers continue to be collected in a banal, unresponsive, untimely fashion that does not result in any meaningful feedback for the program tactics and initiatives. In defense of the operational staff, the collection, tabulation, and analysis of these data is tedious, boring, and time-consuming. Still the net result is that antimalaria tactics are applied in an unimaginative, bureaucratic fashion, usually without any regard to current vector bionomics or epidemiological factors.

Where epidemiological data is already being collected in logbooks, computerization of the data collection and analysis is a clear solution and no longer impractical. Given the rapid decline in size and price of computer hardware and software, that part of the solution is now close to trivial. Maintenance and repair is a spare-parts supply equation, not insurmountable. The limiting factor would be availability of motivated and conscientious local staff to implement the system. In its first phase, this is not something to be initiated on a global scale. Unfortunately, the evaluation of any trial project will be seriously biased, as all trial projects are, by the use of the best staff to implement it.

Furthermore, the computerization of all national health statistics can be introduced through the malaria program. In many national health systems, it is the malaria program that has the best-developed reporting system infrastructure which can then be the basis of introducing the computer system, and from which it can be expanded to report all health statistics in the country. The simple, swift tabulating power, plus the analytical capabilities of the computer can rationalize and maximize the budgeting impact of the miniscule amounts available for health in many of these countries.

USAID could fund the development and testing of a demonstration of a computerized statistical reporting system for operational malaria programs. This would involve the selection of appropriate hardware (from currently available microcomputers), and the adaptation of currently available database software. Such a system would be designed for easy data entry by relatively naive typ-
ists (even typing may be unnecessary with the recent introduction of cheap optical character readers). After that step, it would provide analyzed graphic output that middle and senior level staff could use for timely, responsive actions. For example, the computation of moving averages could be used to recognize epidemic outbreaks and then acted upon promptly and rationally; data could be stratified and analyzed for epidemiological factors relating to transmission; case investigations could be linked over time.

OPTION 2

The rapid advances now being made in molecular biology and immunology are providing powerful, yet simple to use, new research tools. It is now feasible to conduct sophisticated serological investigations, either near the field or in collaboration with a distant research institution, due to the portability and stability characters of the newer techniques. This can be exploited to revitalize operational research in malaria. New ideas and new thinking are needed. For example, the recently developed method\textsuperscript{1,2,3} of diagnosing sporozoites in mosquitoes to species level and quantitating the infection load can be used to incriminate new vector species, to investigate transmission characteristics of vector species, and differentiate between the greater and lesser important vector species. Serological diagnostic tests, especially ELISA techniques, are being developed in the research laboratory, which may greatly improve rapid diagnosis of malaria, but of immediate interest is the number of tests that can be performed on serum samples from a filter paper eluate. The scope for analyzing immunity status in diverse transmission conditions is just now being realized. DNA hybridization techniques for malaria diagnosis are still early, but refinement could swiftly provide another useful tool.

Thus, epidemiological studies are now becoming possible that investigate the immunological status of populations in endemic conditions before and after antimalarial interventions. This is a critical area of current ignorance, since the relative merits of various interventions can only be hypothesized. A recent comparative study of malarial immunity in Sudan and Indonesia\textsuperscript{4} suggests that very different mechanisms may function in malarial immunity in different population groups.

USAID could fund the training of national personnel in the latest techniques of immunologic and molecular biologic research with application to malaria. This would be of two types: a) very practical short-term training in-country by consultantships for visiting foreign experts, coupled with bilateral research support, and b) longer term traineeships for overseas study by local staff. USAID may want to solicit proposals for modest 2-5 year research projects that emphasize the bilateral collaboration of malaria research centers in the United States with those in malaria-endemic countries. These research projects should focus on the application of the newest technology to quickly bring out new knowledge about transmission of malaria in specific countries. There should be an explicit recognition of the two-way flow of ideas and opportunities.

It should also be noted that Thailand already has several thousand trained researchers who could carry out this type of research.