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and Control Project

Pakistan Malaria Control II (1982-1992)

Final Evaluation of Malaria Control Project

August - September 1992

by

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Acronyms and Abbreviations

ACD	Active Case Detection
A.I.D.	Agency for International Development
An.	*Anopheles*
API	Annual Parasite Incidence
AJK	Azad Jammu Kashmir
BHU	Basic Health Unit
CDC	Communicable Disease Control, Ministry of Health
CTD	Control of Tropical Disease Division (WHO)
DHO	District Health Office
DOMC	Directorate of Malaria Control
EA	Environmental Assessment
EC	Emulsifiable Concentrate
EPA	Environmental Protection Agency
ERT	External Review Team
GHS	General Health Services
GOP	Government of Pakistan
GR	Geographical Reconnaissance
HCH	Hexachlorocyclohexane (=BHC)
HIS	Health Information System
HPN	Health, Population and Nutrition (Office, USAID/Islamabad)
LTA	Long Term Advisor
MCC	Malaria Coordination Committee
MCP	Malaria Control Program
MOH	Ministry of Health, Special Education and Social Welfare
MSF	Médecins Sans Frontiers
MT	Metric Ton
N/A	Not Available
NGO	Nongovernmental Organization
NIMRT	National Institute of Malaria Research and Training
NMCP	National Malaria Control Program
NWFP	North West Frontier Province
OP	Organophosphate
OPD	Outpatient Department
OR	Operational Research
PACD	Project Assistance Completion Date
PCD	Passive Case Detection

PID	Project Identification Document
Pf	*Plasmodium falciparum*
PP	Project Paper
PUO	Pyrexia (fever) of unknown origin
RHC	Rural Health Center
SCARP	Salinity Control and Reclamation Project
SMO	SCARP Monitoring Organization
ULV	Ultra Low Volume
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USAID/LTA	USAID Long Term Advisor
VBC	Vector Biology and Control Project
VC	Voluntary Collaborator
WHO	World Health Organization
WDP	Water Dispersible Powder
WP	Wettable Powder

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Executive Summary

The final External Evaluation of the Malaria Control II Extension Project was held from August 24 to September 22, 1992. The objectives were to assess the success of the Malaria Control Program in achieving the project goals and purposes and to evaluate the overall and provincial malaria situation, vector control and spray operations, progress in entomology, in-country training programs, status of surveillance, chloroquine-resistant falciparum malaria, manpower development, and operational research. In addition, the team was asked to recommend strategies for future control of malaria by the Government of Pakistan, in view of the termination of the Project on September 30, 1992. A team of six experts selected by the GOP, USAID, and WHO spent approximately 27 person weeks for this task. The team was briefed by USAID, GOP, and WHO, all provincial health departments, and the Lahore and Karachi municipal health departments. Field visits were made to various malaria and general health service facilities and several villages.

A debriefing session was held with the USAID Mission Director, Deputy Director, and HPN staff on September 20. On September 21 a summary of the findings was presented to the Pakistan Director General of Health and his staff, provincial health authorities, and DOMC personnel. On the following day the team's findings and recommendations were discussed in detail at an all-day workshop with participants from the DOMC, provincial health services, and USAID. At this workshop all recommendations were accepted and a plan of action was adopted for their implementation.

The team observed that during the life of the project malaria transmission has been contained at an acceptable level while insecticide usage was gradually reduced. The project has not reached the stated nationwide target of maintaining Annual Parasite Incidence (API) at or below 0.5 cases per 1,000 population but reported an acceptable API of 0.89 for 1991, based on the rural population. In 1991 Punjab was the only province to maintain the incidence below 0.5 cases per 1,000, with a reported API of 0.3. The proportion of slides taken by passive case detection was 25% in 1991, an improvement from previous levels but still is far from the intended target.

Experience has shown that the malaria situation in Pakistan has deteriorated whenever external donor assistance has ceased. The GOP must demonstrate increased self-reliance even as it seeks alternative sources of external funding for unavoidable imports such as insecticides, spare parts and other commodities, at a cost estimated at about US$ 5 million per year.

As dependence on insecticide spraying is reduced, a new malaria control strategy must be based on better knowledge of the epidemiological situation. An information system must be developed, sensitive enough to provide early warning of epidemics and to monitor the situation. Operational research must be given higher priority, to design and implement the program in a cost-effective manner, so that control efforts are focused on localities at highest risk. Specific studies must be conducted to gain an understanding of the significance of various risk factors that are used in the refinement of stratification. The role of *Anopheles stephensi* and other domestic anopheline mosquitoes in malaria transmission must be clarified. The general areas in which OR is needed are: entomology and vector control; epidemiology and data management; and laboratory and clinical.

The transmission of *Plasmodium falciparum* must be carefully monitored, as this species now constitutes 40% of all malaria cases and chloroquine resistance is widespread.

A reduction in the number of houses programmed for spraying has been gradually attained, since 1988, in accordance with the adopted policies. The percentage of houses to be sprayed is already well below 25% of existing houses, without noticeable negative effect.

The process of integrating malaria control into the health sector, which is under way, must be extended throughout the rural areas of all provinces of Pakistan, both to obtain information and to make diagnostic and treatment capabilities more widely available. The reduction in entomological surveillance is acceptable as long as emphasis is placed on increased case detection and treatment. However, as insecticide coverage is held level or increased, surveillance activities will need to be strengthened.

Well-established malathion resistance in *An. stephensi* and the potential for increased resistance in the primary vector, *An. culicifacies*, present serious problems for vector control strategies. Because of the diminishing efficacy of malathion, routine insecticide susceptibility testing must be increased, and extended to other classes of insecticides that may be required in the future. The cost-effectiveness of any new insecticide should not be calculated on cost per ton or per applied area, but expressed in terms of reduction of transmission in comparison with malathion. For this analysis, detailed epidemiological and operations research information is essential.

There is a need to provide better career development opportunities to the MCP/MOH malaria control staff in order to maintain those who are needed in the service and to attract people with broad competence for future positions of responsibility. Some senior staff posts remain vacant and few young people are available. With the termination of donor support, malaria control operations face many additional difficulties, but the staff problem must be given a high priority.

Intersectoral coordination must be established with agriculture, irrigation, education, and other relevant areas of national and provincial governments. Links should also be established with academic institutions. The team believes that under the present conditions, including GOP budget cuts, withdrawal of donor funds, and increased rainfall and flooding, the GOP will find it difficult to sustain an effective malaria control program. The team urges the GOP to strengthen the national Malaria Coordination Committee.

1. Introduction

1.1 Historical

Malaria has been a constant threat to Pakistan. According to estimates, an epidemic in Punjab in 1908 caused 300,000 deaths. Before 1961 there were an estimated 7 million cases and 100,000 deaths annually. With USAID assistance in the then Global Malaria Eradication Programme (1962-74), the number of cases was reduced to about 9,500 by 1967. When USAID support was terminated in 1966, the Pakistan program was considered close to successful eradication. A resurgence of malaria had already begun, however, and by 1972, there was an epidemic leading to perhaps 10 million cases in 1973-74. Because vector resistance to DDT and HCH had become widespread, malathion was introduced in 1976 and a 99% reduction in malaria cases was achieved. USAID assistance to the Pakistan Malaria Control Program (MCP) was renewed in 1975 and MCP activities saw a reduction to 12,300 cases in 1979. By 1981, the incidence of malaria began to increase again, possibly related to the influx of several million refugees from Afghanistan, many infected with malaria.

In May 1982, the Malaria Control Project II was signed to assist the GOP in maintaining the malaria Annual Parasite Incidence (API) at or below 0.5 cases per 1,000 population funded to September 1987. An extension in 1987 continued the Project until September 30, 1992.

In addition to USAID/Islamabad, the WHO and the Government of Japan have also provided assistance in malaria control efforts.

The MCP II (371-0472) was designed to help the GOP achieve self-reliance in malaria control operations. Its objectives are functional integration of malaria control with general health services, development of an operational research capacity, and implementation of cost-effective vector control measures. These objectives are to be achieved by reducing the use of imported insecticides and increasing reliance on alternative means of control. An active, productive operational research program and efficient management of malaria control operations are critical to achieving these objectives.

1.2 Description of the Project

The Malaria Control II Project was designed to build on previous achievements by assisting the GOP to contain or further reduce the incidence of malaria by: 1) expanding the capacity and increasing the capability of the federal, provincial, and municipal health services to effectively control malaria; 2) assisting the MCP to move from a vertically organized program emphasizing total-coverage house spraying and active case detection surveillance methods to an integrated program using a selective mix of vector control measures and a better balance between active and passive case detection and treatment methods. Successful execution depends on the following key variables: 1) vector resistance to organophosporous insecticides; 2) epidemiologically accurate direction of spray operations; 3) cooperation and participation of the general public and general health services staff; 4) reduction of the incidence of *P. falciparum* malaria; 5) collaboration of municipal authorities; and 6) expanded use of feasible alternative control measures.

The original MCP II (1982) consisted of four components:

1. **Program Management**: Short- and long-term technical assistance to strengthen the GOP MCP in the areas of program management, epidemiology, evaluation, surveillance, urban malaria control, and safe handling of insecticides;

2. **Training**: Short-term technical assistance to strengthen the capacity of the National Institute of Malaria Research and Training (NIMRT) to meet the research and training needs of the MCP; support for short term fellowships and in-service training programs for malaria and general health services personnel in specific aspects of malaria control;

3. **Basic and Operational Research**: Short-term technical assistance, supplies and equipment, and budget support to conduct a variety of field studies; and

4. **Commodity Support**: Insecticides, urban control vehicles with space spraying machines, malaria control vehicles, microscopes, and other necessary commodities.

The 1987 extension modified the MCP II by 1) changing the use of residual insecticides to restricted areas where epidemiological evidence clearly dictates such application; 2) strengthening the capacity of the GHS at federal, provincial, and municipal levels to provide malaria surveillance, treatment, and case follow up; 3) addressing staff deficiencies to promote essential training and operational research; 4) replacing temporary control measures — insecticidal interruption of malaria transmission, chemotherapeutic case treatment and reduction of the parasite reservoir — with more permanent long-range control techniques. Success of the MCP II was to depend on the following factors:

1. Operational research on mosquito vectors and selection of alternative insecticides;

2. The cooperation and participation of the GHS staff and utilization of the primary health care system in surveillance, case detection, and treatment;

3. Reduced reliance on active case detection (ACD) and priority given to passive case detection (PCD) based on laboratory-established malaria infection among those seeking treatment at fixed health facilities, to a target of 70% of all case detection; and

4. Accessibility of governmental slide examination facilities to non-governmental treatment sources (physicians, pharmacists, traditional healers) throughout the country; and the dissemination of staffed, fixed facilities in rural communities.

1.3 Previous Evaluations

The MCP II Project Paper (1987 extension) specifies that:

A month-long program evaluation will be carried out in each year of the project by a joint GOP/AID/WHO team supplemented by one project-financed external consultant. Representatives of A.I.D. will include an A.I.D./W malaria specialist, the A.I.D. project-financed long-term advisor, and one or two members of the Mission's Office of HPN.

WHO representatives will include the local WHO representative in Islamabad or his designee.

Although the composition of evaluation teams has varied from year to year, annual evaluations have been carried out as specified. In addition, various aspects of the MCP II, have been evaluated by short-term consultants, whose reports are cited in the appended list of References.

2. Progress in Achieving Project Goals

The overall goal of the Pakistan-Malaria Control II Extension, USAID Project No. 391-0472, is to reduce morbidity and mortality from endemic diseases, especially malaria, through a nationwide health delivery system. The more specific purposes of the project are to assist the Government of Pakistan to contain and further reduce the incidence of malaria in the country, maintaining malaria incidence at a level where it does not constitute a major public health problem, as well as to train a cadre of technical personnel to sustain the control program without or with only a minimal requirement for external assistance.

The specific objectives of the project and the summary findings of the Final Review Team are as follows:

2.1 Maintain an Annual Parasite Incidence (API) at or below 0.5 cases per 1000 population.

The reported national API for the period 1987-1991 was:

Year	1987	1988	1989	1990	1991
API	0.98	0.87	1.49	1.11	0.90

The reported API by province was:

Year	1987	1988	1989	1990	1991
Punjab	0.64	0.50	0.79	0.36	0.31
Sindh	1.69	1.32	3.74	2.46	1.76
NWFP	1.86	1.75	2.03	2.36	2.19
Baluchistan	0.28	0.85	0.63	0.12	0.66

NOTE: These figures are based on rural population only. If the total population is considered in the denominator, the API will approach the target more closely.

The project has not reached the stated target but has managed to keep the malaria situation under control. Malaria has not become a major public health problem. It is to be noted that during the peak of the epidemic of 1972-1973 the API was 14.6 and 13.2 cases per 1,000 population, respectively.

In 1991 Punjab was the only province to maintain the incidence below 0.5 cases per 1000, with a reported API of 0.3.

The API in Baluchistan increased from 0.1 to 0.6 cases per 1000 population. This situation may be attributed to the influx of Afghan refugees who have a high malaria positivity rate (34.4 SPR as reported by WHO in the document "World Malaria Situation 1990").

2.2 Contain the infections of falciparum malaria to a proportion of less than 20% of all cases of malaria in Pakistan

The reported percentage of *P. falciparum* infections, in relation to the total number of cases, by province, is as follows:

Year	1987	1988	1989	1990	1991
Punjab	28	28	36	33	30
Sindh	51	55	77	77	68
NWFP	28	25	38	38	21
Baluchistan	58	80	76	76	61

Although no province has achieved the intended target, the situation has improved in the NWFP during the last two years. A better PCD network of health institutions has been credited with improved detection of *P. falciparum* cases. Sindh has had the highest proportion of falciparum malaria during the last three years (although this proportion declined in 1991). NWFP has the lowest rate (21% in 1991) and is close to the target.

2.3 Improve the malaria surveillance system by increasing the proportion and number of blood smear slides collected through a passive case detection (PCD) system within the general health delivery system to exceed 70% of the total number of slides collected for the detection of malaria cases in Pakistan

The percentage of PCD slides, in relation to the total collected by the national malaria control program at the federal level, was as follows:

Year	1987	1988	1989	1990	1991
%:	19	18	22	26	25

The percentages per province were:

Year	1987	1988	1989	1990	1991
Punjab	12	11	15	17	13
Sindh	29	29	48	54	41
NWFP	33	32	25	37	48
Baluchistan	35	22	11	12	20

The proportion of slides taken by PCD at the federal level has increased from 13% in 1985 to 25% in 1991, which represents an improvement but still is far from the 70% intended target.
The proportion of slides taken by PCD by province is highest in Sindh and NWFP and lowest in Punjab and Baluchistan.

2.4 Reduce intra-domiciliary spraying to less than 25% of all houses in the country by determining foci for spray on sound current epidemiological data; attain greater than 95% spray coverage of the targeted housing in foci.

The percentage of targeted houses, at Federal and Provincial level, by year, is as follows:

Year	1987	1988	1989	1990	1991
Federal	N/A	N/A	10	13	12
Punjab	28	21	10	11	8
Sindh	27	20	12	21	23
NWFP	20	16	20	20	19
Baluchistan	8	6	5	7	1

The percentage of houses covered, in relation to those targeted for spraying, at the federal and provincial levels, was:

Year	1987	1988	1989	1990	1991
Federal	N/A	N/A	85	81	78
Punjab	91	92	92	91	92
Sindh	89	72	98	90	91
NWFP	82	91	71	64	67
Baluchistan	56	65	59	56	4

A reduction in the number of houses programmed for spraying has been gradually attained, since 1988, in accordance with the adopted policies. The percentage of houses to be sprayed is well below the maximum 25% of existing houses, without noticeable negative effect. On the other hand, the 95% target for completion of spraying is a rather high goal. However, two provinces (Punjab and NWFP) are close to that level.

2.5 Initiate and assist in the planning and implementation of operational research at the NIMRT, targeting operational problems identified by the Directorate of Malaria Control and/or provincial malaria control programs.

USAID/Islamabad and WHO have sent a number of senior DOMC, provincial and municipal health staff for overseas training in various aspects of entomology. DOMC and NIMRT provide junior staff with training in entomology, safe handling of insecticides, and insecticide resistance monitoring. Long-term sustainability of operational research may be weakened through decreased budgets and staff retirements and transfers. A briefing document from Baluchistan notes that more professional training is required and that lack of interest is evident in some staff (34).

2.6 Promote and assist an appropriate utilization and expansion of the already trained but today unsupported network of voluntary village health workers to more than double the number of static PCD posts.

A pilot project on the utilization of voluntary collaborators (VCs) was carried out in Punjab, in two districts. 50 VCs were selected. As evaluated by a previous External Review Team (1990) the trial was exceptionally successful. However, due to administrative shortcomings, the project was terminated. No attempt has been made to duplicate it elsewhere. Therefore the target has not been met.

2.7 Specific target output indicators for last three years

2.7.1 Administration: Maximum 5% of staff vacancies at headquarters and provinces

It was reported that the vacancies have been maintained at a level of 5% or less during the period 1987-1991. A key post of director remains unfilled.

2.7.2 Program planning

Annual plan of action

This has been achieved for the period under review.

Safe handling of insecticides

There is a plan for yearly training on insecticide safety, cholinesterase testing and monitoring of early symptoms of insecticide intoxication, at provincial and district level.

2.7.3 Transport: Target for total fleet "out of service" is less than 10%

	Total Provided	Out of Service Number	Percentage
DOMC/HQs	5	0	0
Punjab	50	*	*
Sindh	30	6	20
NWFP	29	9	31
Baluchistan	14	6	42
NIMRT	8	1	12
AJK	7	3	42

Vehicles assigned to Punjab are mixed with those of the GHS and are not easily identified.* The target has been achieved at DOMC. The target of less than 10% in the other provinces has not been achieved.

2.7.4 Training

Overseas training. During the six year period 1987-1992 nine long term and 136 short term overseas training courses were completed.

Training on safe handling of insecticides is given at provincial and district level and at NIMRT. The number of trainees at provincial and district level is more than 2,000 per year, including malaria supervisors, inspectors, superintendents, CDC officers, microscopists, and assistant entomologists.

Training has been close to the target.

2.7.5 Spray operations

	1989	1990	1991
Percentage of Total Houses Targeted	<25%	<25%	<25%
Percentage of Houses Planned	10.8	14.2	12.5
Percentage of Targeted Houses Sprayed	85.3	81.1	78.1

The spraying operations were planned as per adopted target (<25% of existing houses); however, the actual execution was short of the intended coverage targets, which were 93%, 94%, and 95% respectively for the three year period under review.

2.7.6 Surveillance

		1989	1990	1991
1.	PCD % of Total Slides	43%	56%	70%
	Achieved	22%	26%	25%
2.	Average turn-around slide taken to treatment Target (days)	10	8	7
	Achieved	*	*	*

*Note: Not uniform. From 2 to 20 days, depending on location of post and the facilities assigned to the Districts and the health outlets. In general the turnaround has improved in relation to that observed in previous evaluations (3-30 days) and a relatively high number of slides are examined within a 24 hour period. The briefing document from Baluchistan states that "the blood slides are received from the field to their respective laboratories with an average period of 20 days and some times more. So the average time lag between collection and examination comes to 30 days." (34) This situation is still clearly not acceptable.

Although the proportion of slides taken by PCD is 25%, well below the intended 70% target, that source of surveillance identifies about 65% of the total reported cases on a countrywide basis (year 1991) and in some districts the proportion is even higher (80%).

As stated by a previous review team, the 70% target for PCD in the conditions of the country is unrealistic, and should be scaled down to a more attainable goal of perhaps 40% in future plans.

Laboratory services error rate checked.

	1989	1990	1991
Target	<1%	<1%	<1%
Achieved	Yes	Yes	Yes

There is a good system in place to cross-check 10% of all negative slides and all positive blood smears, with provision for retraining of laboratory technicians and assistants on malaria microscopy whenever it is necessary.

2.2.7 Evaluation

Annual Program-wide Evaluation by ERTs	1989	1990	1991
Planned	1	1	1
Achieved	1	1	1

2.7.8 Entomology

There are two entomological aspects: the reduction of reliance on expensive insecticides, and strengthening the capacity for operational research and training, in the goals of the project (1 and 3). The criteria for spraying (6, 26) were outlined in the 1987 ERT Report (6) and updated in 1991 (25). The criteria have successfully reduced the procurement of insecticide from 4000 MT in 1985 to 1700 MT in 1991. In 1992 it was 1400 MT and 1000 MT is held for 1993. The reported annual incidence of malaria has dropped from 13 cases per thousand population in 1973 to 0.89 cases per thousand population in 1991 (26). In 1991 consolidated insecticide coverage included only 1,512,556 houses of a total of 13,133,568. Substantial progress has been made in reducing reliance on insecticides. (18)

There is concern that the 1992 rainfall and flooding may greatly increase vector densities. Using average mean temperatures for September and October increased malaria transmission is possible. Stockpiles of insecticides and antimalarial drugs are maintained by DOMC for emergency distribution, but no written contingency plan has been prepared.

The nation-wide network for monitoring malathion susceptibility has been only partially effective. Provincial senior staff have not followed-up on many reports of resistance in *An. culicifacies* and *An. stephensi* and the testing tends to be confined to only a few areas in some provinces. Although resistance in *An. stephensi* is widespread it does not appear to have interfered seriously in control of malaria transmission. Resistance has not caused changes in the criteria for spraying (14, 13, 16, 17). However staff at MSF have noted a certain difficulty in achieving a satisfactory level of control using malathion in some refugee camps.

Toxicological problems with malathion have not occurred and training and supervision on safe handling of it appears effective. Baluchistan has reported problems of refusals of house spraying because of the malathion smell (34). Training and supervision must remain a continuing function of DOMC and additional retraining and supervision will be necessary when another insecticide is used (7, 12, 16)

Neither biological/chemical larviciding nor source reduction have been utilized to any degree beyond urban areas. Several USAID/Islamabad consultants in these fields (9, 21) concluded that in most of the rural areas vector breeding is too extensive to utilize these methods. Closer linkages with irrigation and organizations involved with drainage, including de-waterlogging projects may promote an awareness of health problems associated with water management, some reduction of breeding sites and potential new tools for malaria stratification.

Routine entomological activities may have decreased during the life of the project, because of the shift away from insecticide use, unavailability of vehicles, lack of work during the cold season, and the increase in non-entomological duties assigned to the entomology staff. Observations relating vector species and their densities with risk factors such as yearly patterns of average rainfall and temperature by month and waterlogging should have been made.

Considering the physical facilities, resources and staff, the NIMRT has done a remarkable job in operational research. Nevertheless, little real progress has been made. This year two major entomological studies are being undertaken: the role of *An. stephensi* in malaria transmission and the selection of alternative insecticides. These studies should have been done earlier and it is questionable if resources, including staff, are adequate for continued research at NIMRT.

3. Evaluation Results - Findings

3.1 Current Status of Malaria in Pakistan

The main objective of the plan was to reduce and maintain malaria incidence at a level where the disease is no longer a major public health problem. The review of the data indicates that this objective has been achieved in the country as a whole as mentioned in section 3.1. It is to be noted that there is a continued decrease in API in 1991 over the figures for 1989 and 1990 for the country.

As regards the situation in the provinces, in 1991 the API in Punjab has fallen to 0.31 per 1000 population, which is below the target of 0.5 adopted by the Project. In the remaining three Provinces the API has generally decreased from the 1990 level thus showing a continuing favorable trend, the only exception being Baluchistan, which although showing an increase during the year, still does not exceed the target level by a large amount. This overall reduction in API has been achieved despite such adverse factors as refugees, resistance of *P. falciparum* to chloroquine and a degree of resistance of the main potential vectors to malathion.

During 1991 the slide positivity rate (SPR) also showed a decline in parallel with the reduction in API. The total number of positive cases recorded by the DOMC was 66,586.

The percentage of *P. falciparum* cases reported in the country as a whole was 40.4% which although showing decline from 1989 and 1990 still exceeds the target by a fairly large proportion, Sindh and Baluchistan being the worst affected.

With regard to the surveillance system the percentage of PCD slides in relation to the total collected by the National Malaria Control Program showed little change between 1990 and 1991, remaining about the level of 25%. Although this level of PCD slide collection does not reach the rather high target which has been set, the majority of cases are, nevertheless, detected by this method. The range for PCD slides is fairly large, lying between 13% for Punjab and 48% for NWFP.

Although there is an increasing number of rural health centers and basic health units in the country, equipped with trained personnel and equipment for the microscopic diagnosis of malaria, there are grounds for some concern regarding the utilization of these health facilities by the population. Some estimates suggest that the level of utilization may be even less than 10% of the population of the catchment area (39).

Some factors with major potential influence on malaria transmission include such things as population increase, which is estimated at 3.1% per year, seasonal migration patterns between rural and urban areas, increasing peri-urban settlements and agricultural patterns. An increasing burden has also been laid on the malaria control program by the Afghan refugee influx which amounts to over 3 million people. Although the health care for these refugees is provided mainly by the UNHCR and NGOs, the camps are located to a large extent in close contact with Pakistani villages, and may constitute a considerable epidemiological risk for the local population.

It is recognized that Punjab is the center of most agricultural production in Pakistan, and this Province contains about 60% of the rural population. During 1991 this Province was responsible for 21% of the total cases reported by DOMC in the country, but this epidemiological situation may be adversely affected by the current flood disaster in that region, together with the neighboring Province of Sindh which in 1991 contributed 33% of all reported cases.

During the contacts of the team with health authorities and with individuals living in rural communities it was apparent that they are aware of the malaria problem and its potential consequences and the activities of the malaria program were well received.

Malaria control spray operations are based on the identification of foci according to established malariometric criteria i.e. 5 *P. vivax* or 1 *P. falciparum* indigenous cases, with the localities demonstrating resistance being given priority and also a negative locality if surrounded by positive localities. These are targeted for spraying (1 cycle) with malathion, with certain limits depending on the size of the locality. The decision of spraying is taken after studying the overall situation of the previous year in planning meetings held at Provincial level with the participation of federal and provincial staff. In 1991 the percentage of targeted houses for the whole country was 11%. Of these, 72.4% were actually sprayed.

3.2 Malaria Vectors

Although there are many anopheline species in Pakistan, *An. culicifacies* and *An. stephensi* are considered the only potential vectors (25). Both of these nominal species are known to be complexes, but little research has been done to separate the components of the complexes which are present in Pakistan, nor to map their distribution.

Anopheles culicifacies is considered to be the major vector and is found primarily in rural areas whereas *An. stephensi* is reported as more urban but its range seems to extend into rural areas (20). Both are considered to be zoophilic and endophilic and no behavioral changes have been confirmed.

For years controversy has existed on the role of *An. stephensi* in transmitting malaria (20). It appears to have been the dominant species in some outbreaks, especially those that were more urban. Sporozoites have been found in a few field collected specimens and vectorial competence has been demonstrated in the laboratory.

Recently USAID/Islamabad consultants prepared a protocol and selected study sites to clarify the role of *An. stephensi* in the transmission of malaria in Pakistan (22). The protocol was reviewed by the USAID long-term malaria advisor and by the NIMRT. In view of the limited manpower available for operational research, changes were suggested to broaden its scope and to facilitate its implementation. USAID/Islamabad will provide funding for this research and the responsibility for its completion rests with the NIMRT. The ERT examined the protocol and noted that except for the ELISA sporozoite tests, the other research was routine. The villages are in areas with a recent history of relatively high malaria transmission, but concern was voiced on the sample size. The NIMRT defended the sample size because of constraints of staff. In light of these factors, the sample size was logical.

Staff of provincial malaria control programs should make a special effort to collect and pool *An. stephensi* and other species in contact with man in malarious areas. Specimens could be transported to NIMRT, examined to confirm species, and subjected to ELISA testing. This was already under consideration by NIMRT. The MSF is also prepared to begin a similar study in refugee camps in NWFP.

3.3 Vector Control Methods

Vector control is done by three different groups in Pakistan. The DOMC supervises, coordinates and advises malaria vector control at the provincial and peripheral levels. All levels are involved with planning for residual spray coverage and USAID/Islamabad has a role in securing insecticides, transport and spraying equipment (26). Once the commodities are received they are distributed to the provinces and the districts. During the life of the project, malathion has been the insecticide of choice, largely on the recommendation of most consultants. Widespread resistance in *An. stephensi* has caused considerable discussion on the merit of this decision. Some fenitrothion has been used during the life of the project but for toxicological reasons its use was discouraged. Resistance to malathion has also been recorded in *An. culicifacies* but its significance remains to be evaluated. There are records of fenitrothion resistance in both species. Permanent staff handle the supervision of spray operation, training of temporary spraymen and record keeping.

The malaria vector control in refugee camps is done by UNHCR with some assistance from MSF and GOP. Insecticide and spray equipment are provided by UN organizations and some NGOs. Except for using fenitrothion briefly upon the recommendation of one of their consultants, malathion has been used following similar criteria as proposed by DOMC. However, this year due to a shortage of insecticide the spray criteria threshold was increased to 10 *falciparum* or 25 *vivax* cases per 1000 population. There is some coordination between UNHCR-MSF and provincial level health staff.

Vector control is done by several municipal corporations and promoted by USAID/Islamabad which also provided vehicle mounted space sprayers and the vehicles. Recently USAID/Islamabad ordered 50 smaller space sprayers for use in narrow streets and alleys where vehicle mounted equipment can not operate. The municipal and provincial governments purchase local insecticides for space spraying and larviciding. Since urban conditions are more conducive to larviciding and environmental management/source reduction, the majority of alternative vector control strategies have been carried out in the cities. Because of

the large numbers of culicine mosquitoes, pest mosquito control rather than vector control is the major activity in the urban areas. More evaluation of larviciding activities is needed.

Insecticide resistance has been a concern since the beginning of the project. Resistance to malathion has been monitored in each province and at specific sites such as refugee camps. USAID/Islamabad has furnished consultants in insecticide resistance and the genetics of resistance. Resistance is growing in *An. stephensi* populations. UNHCR has used fenitrothion, which was also utilized at the provincial level by DOMC in the early 1980s. Resistance appears low in *An. culicifacies* and resistance to malathion in *An. stephensi* seems not to have adversely affected control. Most consultants recommended the continued use of malathion with emphasis on monitoring its resistance throughout the country. Field and laboratory trials are underway to select alternative insecticides for use once malathion begins to fail to provide acceptable control.

In Punjab the Malaria Control Program reports a high level of malathion resistance in *An. stephensi* (31). Out of 129 tests conducted in 1991, resistance was noted in 111 tests (90%). To date in 1992, 51 tests were conducted and resistance noted in 47 of them (92%). For *An. culicifacies*, 153 tests were conducted in 1991 and 46 tests in 1992. Survival was noted in 6 tests in 1991 (4%) and in 7 tests in 1992 (15%).

In Sindh there were 20 tests of *An. stephensi* against malathion in 1991, all showed survival. In 1992 up to July there were 2 tests, both of which showed survival. As regards *An. culicifacies*, in 1991 there were 59 tests, 16 of which showed survival and in 1992 there were 26 tests, 8 of which showed survival.

In Baluchistan there was 1 test of *An. stephensi* against malathion in 1991, and 11 tests against *An. culicifacies* (34). All showed some survival. In 1992 up to July there was 1 test against *An. stephensi* and 4 tests against *An. culicifacies*. Again all showed some survival.

In NWFP results were available for tests so far carried out during 1992. For *An. stephensi*, out of 7 malathion tests carried out all showed survival ranging between 22% and 47%. One test was carried out on *An. culicifacies* which showed complete susceptibility. Three fenitrothion tests on *An. stephensi* also indicated complete susceptibility.

Since malaria indicators for 1991 and 1992 show low malaria incidence, no changes in insecticide at this time are immediately indicated. In general susceptibility data are lacking both quantitatively and qualitatively. Besides some tests on DDT and dieldrin, only malathion and fenitrothion are routinely tested despite previous recommendations that carbamates and pyrethroids should also be included.

Residual spraying of houses was not done for the most part in Baluchistan in 1991 but did take place in 1992. In Baluchistan and the NWFP, much of the malaria transmission seems to be related to the movement of refugees. Our limited observations indicated a few anopheline breeding sites near Quetta. Because of the recent heavy rains, it was difficult to ascertain the type and extent of breeding sites in NWFP.

3.4 Urban Vector Control Activities

Although serious malaria transmission in urban areas has been confined to Karachi, the potential for malaria epidemics exists in many large cities. Because of this, malaria statistics from urban areas have been combined with rural data to provide a more comprehensive picture of malaria transmission. USAID will provide 50 small space sprayers that can treat streets in which the vehicle mounted equipment can not pass. The tender for space spraying requires the seller to provide training and includes spare parts. Originally 5 metropolitan corporations were involved in pest control, but 2 additional ones are now involved. It is recognized that the majority of control activities is directed toward pest mosquitoes, but this approach has provided the municipal governments with excellent public relations and the ability to react rapidly to potentially serious epidemiological situations.

Besides adulticiding, emphasis has been directed to larviciding and source reduction. Municipal vector control staff have located breeding sources and have separated them into those that can be subjected to control activities and those where this approach is not practical. The NIMRT has conducted a few trials using larvivorous fish, but this control method has not been considered practical.

Lahore: Emphasis is placed on culicine and other pest mosquito control. About 1,000 ponds are treated with larvicides. Larval populations are monitored to indicate retreatment. Thermal fogging is the choice for adulticiding as it provides a good public response. Spraying is done between March and May at a cost of about Rs 1,000 per hour per machine and vehicle. Most anopheline breeding is at the urban-rural fringe as standing water in the city is highly polluted.

Karachi: The major emphasis of the project is pest mosquito control. This consists of larviciding and source reduction of most major breeding sites and thermal fogging in the 4 political districts. Since adequate epidemiological information is lacking, the Corporation bases control strategy on human complaints of mosquito biting and some larval density studies. A major concern is the availability of insecticides should an emergency arise.

Vector control operation appears to be a success. Reliance on costly insecticides has been reduced without drastic increases in malaria transmission. Increased malathion resistance noted in the two major potential vectors may soon require selection of an alternative insecticide. Field trials have either been done or are now underway to assist the DOMC in the selection of alternatives. However, although these trials appear to be run on a sound technical basis, there is a tendency to consider only the cost per metric ton rather than the cost per square meter treated or the actual reduction achieved in malaria incidence. The cost-effectiveness factor is being included in trials conducted by MSF and there should be close cooperation with the NIMRT which is carrying out related studies.

The impact of vector control on the transmission of malaria has been enhanced, because during the life of the project there has been an improvement in the economic situation in rural areas. The improvement has meant better housing and a large number of villages with electricity both of which have reduced mosquito-human contact. Furthermore, there has not been a recent large amount of rainfall or flooding until this year. No consistent attempt has been made to relate rainfall and flooding to past malaria transmission. Consequently it is not possible to give a reasonably accurate forecast of the effect that these climatic factors will have on transmission.

Little progress has been made to promote personal protection as a means of vector control. According to the DOMC few people utilize bednets in rural areas and it would be extremely difficult to promote their use. However, MSF has supplied partly subsidized insecticide impregnated bednets to Afghan refugees in NWFP and report widespread acceptance and a reduction in malaria transmission. If health education is strengthened a bednet trial might be considered in some highly malarious areas and in parts of Baluchistan where their use has been noted.

3.5 Epidemiology and Surveillance

It has been a continuing goal of the MCP to maintain malaria incidence at 0.5 cases per thousand population, or less. The basis for determination of malaria incidence has been the API, or Annual Parasite Incidence of blood slides. Slides are derived either from Active Case Detection (ACD) within the community, or from passive case detection (PCD), which produces more slides from those individuals with a current fever. As a policy, both the USAID and the GOP have recommended increasing emphasis on PCD. The number of cases reported by PCD approaches the real malaria incidence in the local population to the extent that 1) the population has ready access to a health post; 2) the health post is utilized by the residents who have fever; 3) properly trained staff and appropriate facilities (slides, stain, microscope) are in place; 4) the blood film is properly made and the diagnosis is correct; and 5) the information is appropriately recorded and transmitted to the district, provincial, and central government levels.

Where any of these conditions are not met there is concern that the reported API rate does not reflect the true incidence rate in the population. As an example, it has been reported that the majority of rural populations do not utilize government health facilities. The ERT was told by a MOH official that for each reported case of malaria there are probably ten to fifteen more unreported. It has been reported that an average BHU generally attends less than 10% of the expected number of patients in the target population, and that less than 5% of the total expected patients in the country visited the government health facilities during 1983-84. "For the purpose of health coverage, an average person,

whether rural or urban, depends more on the private than on the public sector." (39) If this remains true, then operational research is urgently needed on patterns of health service utilization.

It is essential that the health authorities are informed of the true incidence of malaria in populations within Pakistan. Such information could be obtained through properly designed sample surveys, investigation of sentinel communities, or other standard epidemiologic methodologies. Activities should be undertaken to improve malaria detection and treatment in all provinces. Microscopy capabilities should be disseminated as broadly as possible within BHUs and RHCs in all provinces to cover the entire population, and health education should be made widely available to inform and motivate the public to use these facilities in the event of febrile diseases.

3.5.1 Health information systems

Malaria case data are generated at the point of patient contact and flow sequentially to district, provincial, and national levels. The ERT followed this process carefully at several localities. Information is hand copied from one form to another at each level, with cumulative loss of data due to summarization, and significant opportunity for introduction of errors. Data are transmitted without analysis or utilization. It is imperative that this system be improved and modernized to facilitate strategic planning of malaria control measures.

Several studies (e.g., 10) have been made of the system by which information is transmitted from the periphery to the DOMC at the national level. Within the current year, each province has been furnished with an Epson 286 computer, a printer, and several programs for recording and analysis of malaria data. The goal, described in reference 19, is to replace all existing reporting methods with a single HIS scheme to be in place by October 1992. This goal will not be met. Unfortunately there have been many errors in specification of hardware. The PAKMAL program, intended to simplify reporting and analysis, has been criticized severely by the only person we saw using it. The maps are too small to be useful, and the program runs so slowly that analysis of data from a single district requires several hours of computer time. Lotus 1-2-3 Ver. 2.3, Epi-Info, and PAKMAL were installed on all computers. In addition, no justification was given for providing such complicated

programs as WordPerfect 5.1, dBase IV, Lotus 1-2-3 Ver. 3.1, Harvard Graphics 2.3, and Norton Utilities 5.0, and it seems unreasonable to expect that individuals lacking experience with computers could master all of these applications. It is unfortunate that such avoidable problems accompanied the introduction of computers, as this creates an unfavorable attitude in the persons for whom the system is intended.

3.5.2 Surveillance: entomology

Many aspects of traditional entomological surveillance have deteriorated since the strategy of malaria eradication ended. Little is known of the presence or distribution of anopheline species other than *An. culicifacies* and *An. stephensi* in Pakistan; many of these other species are recognized vectors of malaria in neighboring countries. Vector density data are underutilized, but some information on *An. stephensi* and *An. culicifacies* distribution is available from collections made for insecticide resistance testing. Municipal agencies doing larviciding have identified mosquito breeding sites. Unfortunately little monitoring of insecticide resistance in anopheline larvae collected from these sites, is done.

Another tool of surveillance, GR, has been weakened since the termination of the eradication program. Mapping of localities and large political divisions was done annually into the 1970s. After that time, only population data were collected, and at present even this does not seem to be done routinely in all districts. Houses at one time were numbered but it was difficult to ascertain the current situation. House cards were observed only in Punjab and these were old and difficult to read.

Senior entomological staff from the DHO upward were trained in entomological surveillance. However, these individuals have been assigned multiple duties and we saw little evidence that proper entomological surveillance was being done. Unfortunately many of these individuals will retire in the next few years and their expertise will be lost.

Even though reliance on residual spraying of houses has been reduced, the lack of emphasis on entomological surveillance has reduced the ability of the malaria control program to effectively react to emergencies and to adjust control activities where and when needed. Furthermore, accurate information on breeding sites, vector densities, rainfall,

humidity, temperature, and GR could be utilized to predict malaria transmission and to define micro-stratification risk factors. Dr. J. A. Rozendaal (USAID/LTA) has presented an interesting theory regarding water-logging and distribution of falciparum malaria. He has survey maps of water logged areas and these correspond with highly malarious areas. This theory was discussed by Dr. Rozendaal with experts from CTD in WHO, who have encouraged further study.

3.6 Stratification

It has been recognized that the stratification of malaria is a useful tool for planning malaria prevention and control activities. The concept has been applied through a variety of approaches, starting from the most simple method of utilizing existing API data, to the incorporation of long term study and forecasting of climatological parameters, and the study of socio-economic factors.

Regardless of the simplicity or complexity of the approach chosen by an individual malaria control program, the epidemiological stratification involves a "continuous dynamic process of research, diagnosis, analysis and interpretation of information that serves as the basis for methodological, comprehensive categorization of geoecological areas and population groups according to the risk factors for malaria."(40)

The components of this process involve:

- Study of API and trends in to identify priority areas;
- Epidemiological assessment of risk factors;
- Mapping of strata in accordance to risk;
- Selection of interventions for each stratum;
- Involvement of health services in implementing actions;
- Selection of indicators of structure, process, impact;
- Evaluation and adjustments.

Any condition or circumstance that increases the probability of the appearance of malaria morbidity or mortality is considered a risk factor. These variables include ecological, geographical, entomological, social, economic and demographic factors, as well as the availability or absence of health care in the communities.

The epidemiologic/paradigm approach is a process that may help to obtain a better understanding of the problem. As postulated by the Committee for the Study on Malaria Prevention and Control convened by the Institute of Medicine - Washington, 1991 (41) this approach would include:

- Classification of types of malaria, such as irrigated agriculture, traditional agriculture, urban, desert;
- Study of determinants, level of endemicity;
- Parasite species (Pf, Pv, Pm, Po);
- Population: Immunity, migration, density;
- Socio-economic factors:housing, occupation, customs;
- Health infra-structure: budget, NGOs, availability;
- Use of drugs: availability, cost, resistance;
- Vector: behavior, susceptibility, control cost; and
- Development projects: Government, private (mining).

Selection of control tools:

- Vector control: environment, personal protection, adulticiding, larviciding, zooprophylaxis;
- medical resources: diagnosis and treatment;
- education, information, social marketing (to the general public and to the health providers); and
- Surveillance.

Surveillance:

- Morbidity and mortality;
- Epidemic early warning;
- Vector information (resistance, behavioral changes); and
- Antimalarial drug resistance.

It would be of obvious benefit if some system of risk stratification could be devised in order to assist in targeting priority areas, particularly with regard to the flood emergency. Factors taken into consideration could include: a) Previous background both malariometric and epidemiological; b) Current epidemiological situation, whatever information is available; c) Information on accessibility; d) Previous climatic information, especially temperature readings.

The DOMC has carried out a macro-stratification of the malaria problem based on historical records of API, SPR, and the proportion of *P. falciparum* infections in the areas. The general epidemiological situation, as well as risk factors such as frequency of heavy rains and floods, resistance of Pf to antimalarial drugs, migration of the population, aggregation of labor, have also been taken into account.

As a general policy the surveillance system is the same for all strata. This includes the utilization of PCD posts and ACD activities, complemented by mass surveys when necessary.

The use of insecticides has been restricted to <25% of the total number of houses and at present is being applied to about 11% of existing houses. The decision to spray or not to spray is taken independently of the strata where the houses are located. This decision is taken at provincial level, in yearly meetings where the epidemiological information is analyzed.

3.7 Chemotherapy and Chloroquine Resistance

The DOMC's malaria treatment protocol, as reviewed by the WHO, is shown in the supervisor's manual and on plastic laminated treatment cards that are distributed to MCP and GHS workers. No relapses of vivax malaria have been reported following the recommended five-day treatment, and recommended treatment regimens for both vivax and falciparum malaria are still valid. Chloroquine remains the drug of choice for all cases of malaria. To prevent dissemination to other persons, primaquine must be added to the presumptive dose of chloroquine if drug-resistant falciparum malaria is suspected.

If a course of radical treatment with chloroquine and primaquine is not effective in eliminating chloroquine-resistant falciparum malaria, an alternative drug, preferably Fansidar, should be used. If the patient is still ill after taking Fansidar, a blood film should be examined. A third line drug, preferably Mefloquine, should be given if parasites persist. Besides Mefloquine, Halofantrine has been subjected to clinical trials and has recently been registered in several countries. According to WHO policy (38), it should be reserved for the treatment of multiple drug-resistant falciparum malaria, and strict governmental control of its importation, distribution and utilization is recommended.

The ERT strongly suggests that *in vivo* testing for susceptibility of *P. falciparum* parasites be carried out promptly wherever chloroquine resistance is suspected. *In vivo* and *in vitro* testing should be extended to other antimalarial drugs commonly used in Pakistan, including Halofantrine, Mefloquine, and Fansidar.

3.8 Operational Research

3.8.1 Entomology

The NIMRT is responsible for vector biology and control research. Protocols, many times with the assistance of consultants from USAID and WHO, are developed and presented to the MCP for peer review and acceptance. Once accepted, the protocol is forwarded to USAID/Islamabad for review and funding. Field level research staff frequently are provided by the provincial malaria control program and DOMC. Until recently the NIMRT had the capability to handle 4 or more vector biology and control and clinical epidemiology research projects annually.

Funds for the NIMRT barely meet the essential requirements , such as salaries, building maintenance and expendable supplies. Therefore all research funding must come from outside the Institute. As a result, the future is bleak for NIMRT (23). The financial restrictions placed upon NIMRT will seriously curtail the ability of the DOMC and provinces to provide effective, flexible, and economically feasible control of malaria vectors, thus undermining much of the current strategy for malaria surveillance and control. The MSF has found that University of Peshawar will cooperate in entomological aspects of operational research and a previous ERT found a willingness to cooperate from faculties of universities in Karachi and Baluchistan. This could lighten some of the load of NIMRT and identify young scientists for recruitment by it and the DOMC.

Research is now on-going to select alternative insecticides and techniques to provide affordable vector control. The WHO Stage 3 field trial with Reldan and Carbosulfan and the A.I.D. sponsored trial with Bendiocarb, Pirimiphos-methyl, Lambdacyhalothrin and Deltamethrin are essential steps for the selection of alternative insecticides (23). The team visited a village recently sprayed with Bendiocarb and observed bioassays

of walls in several houses. Unfortunately there was not much information about the other villages of the trial, collection of pretreatment baseline data, or the spraying operation. It should be emphasized that great care must be taken in supervision, data collection and analysis of all insecticide field trials. The permethrin application to tents and the proposed insecticide impregnated bed net studies by MSF and NIMRT will help to determine new approaches to vector control and the proposed *An. stephensi* study by NIMRT and a parallel study by MSF could affect the overall strategy of vector control.

Continued monitoring of vector resistance to insecticides by DOMC and the provincial malaria control programs should be expanded in number of tests and number of insecticides to guide the government in decision making regarding the present status of malathion resistance and the selection of alternative insecticides.

To keep cost-effective control and safeguard against drastic increases in malaria transmission the government must maintain a level of human resources for research. Numerous consultant reports and the NIMRT annual reports have noted the shortage of well-trained professionals, which is becoming more acute and could cripple the entire research process essential for effective malaria surveillance and control.

Dr. J.A. Rozendaal (USAID/LTA) has prepared a proposal in collaboration with staff of the NIMRT for operational research to develop an improved, more sustainable malaria control strategy, (37). The proposal has sufficient merit and deserves consideration especially the simplified protocol for the role of *An. stephensi* in malaria transmission. The proposal includes several projects that would greatly improve the knowledge of malaria transmission which could be partially implemented by existing DOMC and provincial staff. These projects warrant discussions within DOMC and USAID/Islamabad and a peer review by VBC or WHO.

With the termination of donor support of malaria control, there may be a tendency on the part of MOH to lower its priority for malaria control. Globally this has been the case usually with drastic consequences that have led to a resurgence of malaria with little capacity for a government to react. Every attempt must be made to maintain and strengthen the administrative structure of the DOMC and the other agencies, at all governmental levels, involved with malaria control.

Research is the cornerstone for efficient and effective surveillance and malaria control, and the NIMRT will become even more important as reliance on external donors is reduced. Consequently both the DOMC and the NIMRT must be maintained as viable components of the MOH and the linkage between the two strengthened.

3.8.2 Epidemiology and data management

Accurate epidemiological information and its prompt utilization are basic to any disease control program. The recording and collation of data about malaria cases has been done entirely by hand and because of the need to deal with many individual paper records much valuable information has been delayed, lost, or copied with errors. The application of computer-based information systems is no longer a novelty in developing countries. The methods of operational research can be employed to improve the collection, transmission, and analysis of data in a timely manner. Provincial MCP epidemiologists should make maximum use of the computers provided to them, and the flow of information from the BHUs to the district and provincial levels should be expedited as much as possible.

3.8.3 Laboratory and diagnostic

Laboratories capable of accurate diagnosis of malaria are too few in number. Services should be extended to RHCs and BHUs in rural areas in all provinces. Each province should develop methods to assure that an adequate supply of microscope slides and freshly prepared Giemsa stain stock solution be provided to each microscopist to insure that stained slides are of the high quality needed for an accurate diagnosis. A technician, trained in microscope maintenance and repair, is available to all health facilities in each province.

3.9 Human Resources Development

3.9.1 Entomology

Since 1981 the NIMRT has conducted about 30 courses relevant to vector control, and many other courses which cover certain aspects of vector control. There has been a number of refresher courses, especially on safe use of organophosphate insecticides (30). Although it is difficult

to evaluate course content and teaching proficiency without seeing the didactic material or attending an actual class, the caliber of the trainees appears to be good and the motivation created through these courses provides the MOH with an opportunity to maintain quality staff.

The GOP and USAID/Islamabad provide staff for training in vector biology and control throughout the country and provincial malaria control programs are encouraged to furnish in-service training in these subjects to junior staff. A number of senior staff from municipal, provincial, central government and NIMRT have been sponsored by USAID and WHO for overseas training.Many of these have attended the University of South Carolina program which enjoys a good reputation for providing practical training in entomology, epidemiology and vector control. Some senior entomology staff have been sent to the University of California at Riverside for training in insecticide resistance with Dr. G. Georghiou. Specialized training should be backed by a provision of up-to-date reference materials and access to some current literature. The long-term A.I.D. malaria advisor may be instrumental in providing a compilation of published articles on entomology, epidemiology and control of malaria in Pakistan that can be used for the training of senior staff.

The reduction of qualified staff at NIMRT, who provide training for junior staff, and the disappearance of trained staff from the various activities are considered major problems (30). This situation could be improved by recruitment of recent graduates in biological science. It is obvious that when USAID funding stops, overseas opportunities for senior staff will be reduced, which may affect the proficiency of all entomological and vector control activities within the country.

3.9.2 Epidemiology and laboratory

In 1991 the NIMRT conducted seven training courses with a total of 150 students, of whom 135 passed their respective examinations. Numbers for 1992 are in the same range. The course in detailed microscopy of malaria is of 3 months' duration. In addition to routine microscopist and entomology technician training, the NIMRT is conducting courses on special subjects, such as *in vivo* determination of drug resistance, at the request of DOMC. Provinces pay travel and subsistence costs for their own students.

Because of the nationwide demand for microscopists, the NIMRT conducted a course to train five master trainers from each province. The master trainers then give provincial level courses in malaria microscopy, of one month duration, to those candidates already trained as laboratory technicians or laboratory assistants. For example, the National Institute of Health trains multipurpose laboratory assistants and technicians, but these workers receive only a smattering of instruction in diagnosis of malaria. It is essential that these courses be continued, so that more microscopists are trained at the provincial level, in addition to those previously trained at NIMRT.

The following statements were made in a written brief provided to the ERT (34):

> "The lack of professional training of District Health authorities obstructs the process of carrying out of different Malaria Control Programme activities."

> "The health workers have demonstrated a lack of interest and have not extended their co-operation in taking of blood slides in the OPDs/Dispensaries."

If these problems are widespread throughout the nation, then serious efforts must be made to improve training and to develop a more cooperative and motivated attitude amongst the frontline workers.

To develop and maintain professional competence, interest, and cooperation, there is a great need for training programs, seminars, workshops and refresher courses, particularly for District Health Officers and other medical officers to insure proper integration of the malaria services.

3.10 Health Education

The DOMC employs one full-time health educator who coordinates with radio and television broadcasters and with provincial Health Education officers. Radio messages are being broadcast regionally in Urdu, Punjabi, Sindhi, Pushto, Farsi, Brohi, and Kashmiri. In addition interviews about malaria have been conducted with provincial level health educators as part of regular radio broadcasts of interest to rural

people, and some interviews have been given also to newspaper journalists. Health educators in each province go to schools and villages. The cost of messages in electronic media has been supported entirely by funds from USAID.

3.11 Community Participation

To help improve malaria case detection, a trial program involving voluntary collaborators was started in November in the Kasur and Sheikhupura districts of Punjab province. In each district, five villages were selected in each of five Union Councils. One voluntary collaborator (VC) was identified in each village, for a total of 50 VCs, based on the candidate's willingness to act as VC and his prestige and acceptability in the village. Selection and training of VCs were done by the CDC supervisor of each Union Council, supported by higher echelons as required. Each VC was provided with some training, an illustrated booklet in Urdu, slides, lancets, forms, and chloroquine. The functions of the VC were restricted to making blood slides from fever cases and suspected malaria cases and administering presumptive treatment. Slides were collected by the Malaria Supervisor for staining and diagnosis, and positive cases were followed up. An independent microscopist was denominated in each district to examine the slides from the VCs.

In the first 3 months of operation the 50 VCs collected a total of approximately 2,800 slides. In Kasur only 1 of 2186 slides was positive, but in Sheikhpura, 60 of 615 were positive, 51 for *P. falciparum*. Although it is not known how many of these people would otherwise have come to the attention of health facilities, an important role was defined for VCs at the grass-roots level.

During its visit to Kasur District, the ERT was informed that the VC program was terminated after several months. Major difficulties existed in coordination at different administrative levels, and in funding for replenishment of supplies. Although the 1990 ERT expressed enthusiasm for the VC program, no formal evaluation was undertaken and no repetition of the program has occurred. Another important opportunity for operational research studies is therefore indicated.

It is believed by the ERT that community participation can not occur in the absence of supporting health education to motivate and gain the confidence of the local populace. VCs could be used not only for the functions described above, but also to provide relevant information to their neighbors, and to carry out other functions such as source reduction through the identification, larviciding, and elimination of smaller mosquito breeding sites.

3.12 Integration With General Health Services

There is good integration of the DOMC within the MOH at the national level. A specific example is that the DOMC is providing microscopes and materials to those BHUs nationwide that create a post for a laboratory assistant. In this way the MCP is supporting the stated goal of the MOH to improve laboratory capabilities at the peripheral level. On the provincial level, integration of MCP and GHS is variable. In Punjab integration is more advanced. In Baluchistan the MCP retains its own budget and is almost entirely separate from the GHS. In Sindh there is a separate program with its own work force but with some affiliation with the GHS.

4. Recommendations

4.1 Vectors of Malaria in Pakistan

4.1.1 Vectorial competence of *Anopheles stephensi*

In view of the continuing importance of vector incrimination, ELISA screening facilities should become operative as soon as possible at the NIMRT and at least one other laboratory.

4.1.2 Entomological support

Important support should be provided for program planning of malaria control, through:

a. basic information on vector identity, distribution, seasonal densities, bionomics and insecticide susceptibility status;

b. detailed information for understanding difficult situations in which malaria transmission is not controlled by routine methods;

c. monitoring of program operations to insure that methods used are producing the desired results; and

d. participation in operational research to improve existing control methods and to develop better and more cost-effective ones.

Appropriate support facilities, including transport, should be provided.

4.1.3 Planning control strategies

Malariometric information is necessary but not sufficient to plan vector control strategies, especially if alternative control methods or insecticides are considered. Attention should also be given to results of entomological surveillance, maintaining village maps, and location of vector breeding sites.

4.1.4 Larviciding

The number of municipal corporations doing pest control is growing. The ERT is concerned about the number of insecticides being used. Susceptibility testing of larvae should be implemented, consideration should be given to central purchase of the insecticides and the number of insecticides used should be reduced. Temephos, Actellic, and some biocontrol agents should be considered for treating breeding sites that may be used as water sources for domestic animals and humans.

4.1.5 Alternative measures and integrated control

Control measures other than residual application of insecticides on the interior walls of houses should be studied. Environmental management, larvivorous fish, biocontrol agents, chemical larvicides, and personal protection devices such as insecticide impregnated bednets should be tried, either separately or in an integrated manner according to local conditions. These measures could be evaluated in non-irrigated areas, villages in irrigated areas where water storage ponds and major breeding sites are easily identified, and arid places with limited vector breeding.

4.1.6 Coordination and cooperation

Overall coordination of control of vectors and pest mosquitoes should be improved. In addition to the present coordination between DOMC and province-district level MCPs, municipal corporations and refugee agencies involved with mosquito control should be included. Consideration should be given to intersectoral cooperation with agriculture, irrigation, and salinity reducing agencies.

4.1.7 Insecticide susceptibility testing

Susceptibility testing should be improved in quality and increased in quantity and geographical coverage. In addition to malathion, fenitrothion, and chlorinated hydrocarbons, screening should include carbamates and pyrethroids.

4.1.8 Insecticide trials

MSF is preparing to launch a series of pilot insecticide applications in selected refugee camps. The ERT strongly recommends close coordination among NIMRT, USAID, UNHCR, and MSF for this effort, including appropriate environmental assessment of the proposed trials and analysis of the results with special emphasis on the cost-effectiveness of insecticides that could be considered as alternatives for the malaria control program.

4.1.9 Safe handling of insecticides

When an alternative insecticide is selected, extreme care should be taken to insure its safe handling and use. It is recommended that the insecticide producer or formulator be required to provide training on handling of the insecticide to supervisory staff and to develop teaching aids for junior staff training. A list of any specialized clothing and other protective equipment to be provided to the spraymen should be included. WHO may be approached to provide advice on pesticide safe handling.

4.1.10 Epidemiology and surveillance

Malaria programs are experienced in surveillance methods, but the integration of the MCP into the general health services is making traditional methods of malaria surveillance obsolete. Substantial revisions are needed to make the flow of epidemiologic information rapid and reliable. Such revisions could provide the basis for surveillance of other febrile diseases besides malaria.

Better methods of managing data must be introduced to avoid errors and loss of information, to facilitate analysis and increase the relevance of decisions. Information about demographic characteristics of malaria cases and environmental conditions related to transmission can identify risk factors to target future malaria control activities more effectively. Data collection should be automated at the district and provincial levels using the least complex computers and programs that are capable of performing the needed functions.

Information about malaria incidence should be summarized at the provincial level and circulated monthly, together with current data about other notifiable diseases, to all districts in their jurisdiction. District

Health Officers and Medical Superintendents should receive regularly scheduled briefings, with updates on the malaria situation as well as other diseases of importance. To assure attendance, adequate travel and per diem funds should be made available to participants.

There should be at least one full-time professionally trained epidemiologist per province to collect, compile, and analyze routine surveillance data, conduct studies of malaria transmission, investigate outbreaks, and contribute to planning appropriate control strategies.

4.1.11 Chloroquine resistance

Because it is essential to monitor drug resistance throughout the country, the MOH should coordinate a national program of *in vivo* testing for chloroquine resistance of *P. falciparum*. This should be done on a regular basis in all districts of all provinces. The program should include "early warning" testing of other antimalarial drugs in common use in Pakistan, such as Fansidar and Halofantrine.

4.1.12 Operational research

The lack of progress on operational research has been pointed out repeatedly in previous external reviews. With the termination of USAID donor support it is more essential than ever that careful attention be devoted to ways in which the malaria control effort can be made more efficient, to have the greatest possible cost-effectiveness for reduction of disease.

The operational research capabilities of NIMRT should be strengthened, including closer coordination with malaria related research carried out by universities in the various provinces. This linkage could also be a source of recruitment for replacement of NIMRT and DOMC scientific staff.

Close cooperation and exchange of information should exist between the UNHCR and the Directorate of Malaria Control, to include refugee-related malaria control activities, including spraying operations, case detection, treatment and operational research on vector control. For their mutual benefit, we recommend increased coordination between DOMC

and UNHCR in targeting high-risk areas or populations, collecting and analyzing malariometric data, developing treatment strategies and conducting operational research.

Operational research is required to clarify the extent of utilization of BHUs, RHCs and other government facilities by the public. Studies should be designed and implemented in collaboration with experts from public health and social sciences in Pakistan universities. Such studies could investigate the attitudes of persons in malariogenic regions regarding:

1. The importance attached to malaria as a threat to health;

2. Health care in general and motivations for or against utilization of government clinics, private physicians, and other sources of medical assistance; and

3. Health education messages that would be most effective in motivating people to accept malaria control methods.

4.1.13 Human resource development

Provincial Directors-General of Health, with the assistance of the NIMRT and DOMC, should sponsor educational workshops for District Health Officers on malaria and current control measures. This action would help reduce the occasional lack of understanding of malaria epidemiology and control principles observed on the part of some district health officers, and enhance recognition of the key role played by DHOs in the supervision and support of anti-malaria activities.

A generation of senior MCP staff is nearing retirement, and new individuals must be identified and prepared for positions of leadership. These persons must be trained in program administration and operation as well as in the details of malaria control. Personal qualities of imagination and ability for strategic planning must be emphasized and rewarded with appropriate opportunities for professional advancement.

Individuals in each district must be trained in the method of *in vivo* testing in cases of *P. falciparum* infection for sensitivity or resistance to antimalaria drugs.

For prompt diagnosis and treatment of positive cases, more polyvalent microscopists (lab technician or lab assistant) trained in malaria diagnosis as well as other routine laboratory activities must be placed at all BHUs. Microscopes, chemicals and glassware relevant to malaria should be provided by the DOMC.

The Malaria Coordination Committee should review the current syllabus of training at NIMRT and suggest revisions where warranted to meet current provincial and national needs.

4.1.14 Health education

It is vitally important that all citizens have a basic understanding of the issues that affect their own health and that of their children. All schools should include some teaching about malaria, its effects on health, and general methods of control. Coordination with educational authorities should be carried out to plan the inclusion of malaria information in the school curriculum. Children should be encouraged to transmit this information to their parents and adult relatives. Informative messages should continue to be broadcast by radio and television.

The DOMC and provincial authorities, should inform journalists about malaria through individual discussions, press conferences, and other means, so that information can be disseminated to the public.

4.1.15 Community participation

The experience carried out in two districts of Punjab (1989-90) using Voluntary Collaborators should be extended to all districts of the country, in order to increase the cost-effectiveness of malaria control and involve the community in the protection of their own health. This involvement is a basic element of the Declaration of Alma Ata, a policy agreed to by the Government of Pakistan

4.1.16 Integration with general health services

The integration of malaria control activities with general health services is most complete in Punjab province. The other provinces should be encouraged to follow a similar pattern. Sharing of vehicles and facilities, and use of multipurpose staff at BHU level is encouraged.

4.1.17 Malaria Coordination Committee

Following withdrawal of USAID financial support, the MCC should expand its role in establishing policy and designing, implementing, and monitoring malaria-related activities in Pakistan. The membership of the MCC should be expanded to include the academic and scientific research sectors as well as nonvoting representatives from the UNHCR, MSF and other organizations having significant involvement in malaria control activities in Pakistan. The Committee should request consultation from other ministries and agencies as appropriate to the subject under consideration. As a rule, the recommendations of the MCC should guide the malaria control activities of the MOH. Formal meetings should be held at least twice annually.

5. Blueprint for Government of Pakistan Approach to Malaria Control in the Absence of Donor Assistance in Future

The ERT recognizes that the Malaria Control Program is not sustainable in its present form. Sustainability will depend on the following factors:

1. Commitment and support by governmental authorities at all levels;

2. Motivation and cooperation by the public;

3. Improved case detection and treatment: a) more microscopists at the front line; b) health education to encourage use of treatment centers;

4. Strategic reserve of insecticides, drugs, and other commodities to give flexibility for: a) long term fluctuations in malaria transmission; b) emergency situations;

5. Close monitoring of the susceptibility to insecticides and drugs employed;

6. The accuracy of epidemiological forecasting of critical situations to enable rapid targeting of remedial measures;

7. Increase in intersectoral cooperation; and

8. Implementation of the recommendations presented in this report.

In addition, attention should be paid to: a. distribution and use of critical human resources; b. maintenance of equipment currently available; c. fulfilling recommendations on operational research and training; and d. intersectoral collaboration with other agencies which might support control of vectors, e.g., by source reduction.

Central and provincial governments will have to increase financial support of malaria control activities to compensate for lack of donor support. Donor support should be sought to compensate for any shortfall in budget and any such request should be directed to overall development of malaria control within the general health services. This should not merely be a shopping list to carry on activities as they now exist.

Apart from natural disasters such as the heavy rains and floods, it should be possible to reduce reliance on insecticides through rapid diagnosis and treatment of cases and better identification of risk factors which could be incorporated in the stratification process.

5.1 Vector Control

Despite decades of research on alternative methods of malaria control, house spraying with residual insecticides continues to be the most cost-effective method in Pakistan. There are 1000 MT of 50% WDP malathion available for 1993 and no additional purchases are planned by A.I.D. (26). The DOMC should consider developing a contingency plan to control isolated foci of malaria by requesting sufficient GOP funds to maintain an additional stockpile of approximately 500 MT of malathion or the equivalent of an alternative residual insecticide. At the same time every effort should be made by the MOH to develop micro-stratification of risk areas together with appropriate monitoring in order to enable more accurate targeting of vector control activities (See Annex E).

The contingency plan could consider the past distribution of malaria cases in the foci where annual use of residual insecticide has been necessary, as well as any information on water-logging that may be applicable to selection of malarious areas. With the assistance of past GR information at the locality level, clustering of houses, migratory habits of the population, changes in cluster patterns over time in relation to known mosquito breeding sites, could be analyzed with the objective of reducing insecticide applications and the possible utilization of alternative vector control methods.

Although many alternatives to the present malaria control strategy have been cited and studied by consultants, the tendency exists to maintain the traditional approach of using residual house spraying. This approach has merit but many opportunities exist to advance toward new effective technologies that the government may find more affordable.

5.2 Flood Emergency

As of 9 September, 1992, large areas of Azad Jammu Kashmir, NWFP, Punjab, and Sindh have been affected, together with relatively smaller areas of Baluchistan. One estimate is that 70% of houses have been destroyed in the worst affected areas. This has obviously entailed a corresponding reduction in residual insecticide protection until such time as the houses are rebuilt.

Since electricity supplies have been affected and people are living under more primitive conditions there will be less personal protection than usual. Besides this there will be greatly increased opportunity for mosquito breeding for a certain period as the flood water recedes leaving residual water collections.

The loss of livestock is likely to result in less deviation of biting mosquitoes toward animals and a relatively greater biting rate for human hosts, thereby increasing the chance of transmission of malaria parasites.

There will be difficulties for the population in reaching case detection and treatment facilities and difficulties for the malaria staff in reaching affected areas. It is to be expected also that crowded conditions of any camp for displaced persons will entail risk of transmission as will any migration to towns with increase in peri-urban settlements.

Already there has been a 25% reduction in the budget for malaria control, and there may be even more diverted for other purposes as the full impact of the flood disaster is appreciated.

The above factors place an enormous burden on malaria control activities and will influence the entire program for the remainder of the present year and several years to come.

At present there is in reserve only the 1000 MT of malathion which was already made available for routine use before the flood. This amount will be insufficient to meet emergency needs.

Since areas affected include many of extended agriculture and of outstanding economic importance, the opportunity should be taken of implementing intersectoral cooperation with such Ministries as Agriculture, Irrigation, the Public Works Department, and such others as may be involved, as a matter of mutual interest and support.

The above factors should be taken into consideration should the help of outside donors be sought for flood relief.

Annex A

Scope of Work

The Contractor shall assess the following:

1. The success of the MCP in achieving the project goal and purpose:

Goal: reduce morbidity and mortality from endemic diseases, especially malaria, through the establishment of a responsive, efficient, and effective nationwide health delivery system.

Purpose: To assist the Government of Pakistan to contain or further reduce the incidence of malaria. Measures of purpose achievement by the end of the project period include the following:

1. An annual parasite incidence at or below 0.5 cases per thousand population or 500 cases per million population in each province including urban areas.

2. *P. falciparum* represents less than 2% of all cases of malaria.

3. The number of blood smears collected through passive case detection by general health staff exceeds 70% of the total number of slides collected in the program by all health workers including malaria workers.

4. House spraying coverage does not exceed 25% of all houses in the country and at least 95% of the planned number of houses to be sprayed each season is achieved.

2. The accomplishment of the project outputs listed in the original Project Paper, using the indicators listed.

Outputs: The project purpose will be achieved by (a) expanding the capacity and increasing the capability of the federal, provincial, and municipal health services to effectively control malaria; and (b) assisting the MCP to move from a vertically organized program emphasizing

total-coverage house spraying and active case detection surveillance methods to an integrated program utilizing a selected mix of vector control methods and a better balance between active and passive case detection and treatment methods. The project is expected to produce the following outputs which together should achieve the project purpose:

a. Annual house-spraying programs are targeted specifically to moderate or highly endemic areas based on refined epidemiological analysis.

b. Senior and mid-level health personnel trained in malaria control undertake surveillance as a regular part of their duties, including taking blood smears, administering appropriate drug treatment, and conducting periodic epidemiological analysis.

c. Criteria for selection of appropriate organophosphorus insecticides (malathion or fenitrothion) exist and are applied in the program.

d. Appropriate and effective biological control methods have been identified from field trials and are implemented.

e. A new facility for the NIMRT which is fully equipped and adequately staffed is established.

f. NIMRT's research and training programs meet the priority needs of the GOP's Malaria Control Program.

g. Urban malaria control programs are operating at an expanded level and have reliable and accurate epidemiological reporting systems for programming and policy decision-making.

h. Health education activities have expanded and achieved positive results in obtaining social acceptance of house spraying and surveillance activities.

i. An extended plan of operation for malaria control covering a period of at least three years following the completion of the A.I.D. project (September 30, 1987) is prepared and adopted by the GOP.

j. Participation of females, as both recipients and providers of malaria control services, has increased in surveillance activities.

Indicators

1. Spray Operations

2. Surveillance

   a. Passive Case Detection (PCD)

   b. Active Case Detection (ACD)

   i. ACD blood slide collection should not exceed 10% of the number of cases in the population.

   ii. The average time lag from ACD slide collection to treatment of a positive case should be 14 days or less.

   c. Laboratory Services

The error rate in laboratory examination should not exceed 1%.

3. Transport

The percentage of the total vehicular fleet (excluding condemned, non-repairable vehicles) which is off-the-road at any point should not exceed 10%.

4. Staff

Staff vacancies in the total authorized regular budget should not exceed 5%.

5. Planning

   a. Annual plan of action prepared.

   b. Annual plan for insecticide safety outlining training and safety measures to be taken is prepared.

6. Evaluation

Annual program-wide evaluation is conducted with GOP/A.I.D./WHO participation.

3. The success of the MCP in achieving the project goal and purpose (in the Project Paper Extension):

Goal: reduce morbidity and mortality from endemic diseases, especially malaria, through the establishment of a responsive, efficient, and effective nationwide health delivery system.

Purpose: To assist the Government of Pakistan to contain and further reduce the incidence of malaria in the country, maintaining malaria incidence at a level where it does not constitute a major public health problem, as well as to train a cadre of technical personnel to sustain the control program without or with only a minimal requirement for external assistance.

Specific objectives of the project period include:

1. Support of GOP malaria control objectives to:

    a. Maintain an annual parasite incidence at or below 0.5 cases per thousand population.

    b. Contain the infection of *P. falciparum* malaria to less than 2% of all cases of malaria in Pakistan.

    c. Improve the malaria surveillance system through increasing the proportion and number of blood smear slides collected through a passive case detection (PCD) system within the general health delivery systems which exceeds 70% of the total number of slides collected for the detection of malaria cases in Pakistan.

    d. Reduce intra-domiciliary to less than 25% of all houses in the country by determining foci for spray on sound current epidemiological data; attainment of greater than a 95% spray coverage of the targeted housing in foci.

2. Initiate and assist in the planning and carrying our of operational research at the NIMRT, targeting operational problems identified by the Directorate of Malaria Control and/or provincial malaria control program.

3. Promote and assist in appropriate utilization and expansion of the already trained but to date unsupported network of voluntary village health workers to more than double the number of static PDC posts.

4. The accomplishment of the project outputs listed in the PP Extension, using the indicators listed.

Outputs: The project purpose will be achieved by

a. assisting the MCP to continue its move from a vertically organized program to an integrated program in the total health care system;

b. assisting the MCP to initiate a program mix of vector control methods and comprehensive passive case detection, including case treatment and followup;

c. providing for long and short-term offshore training (266 person-months) of the technical and non-technical personnel in support of the MCP and the NIMRT; and,

d. expanding the capacity and increasing the capability of the federal, provincial, and municipal health services effectively to control malaria;

e. assisting the GOP in planning and carrying out the pertinent training and research essential to (a) and (b) above. The project is expected to produce the following outputs which should achieve the specific project purpose:

a. An annual house-spraying program specifically targeted to endemic areas based on refined epidemiological analysis.

b. Full utilization of the epidemiological criteria for selection of appropriate areas for application of insecticides.

c. An appropriate and effective supplementary biological control method or methods, identified from field trials, will be implemented.

d. Source reduction projects completed in the urban setting and field trials underway on projects in selected rural areas.

e. Urban malaria control programs which are operating at an expanded level and have reliable and accurate epidemiological reporting systems for programming and policy decision-making.

f. An annual plan of operation for malaria control covering a period of at least three years following the completion of the A.I.D. supported project (September 30, 1992) prepared and adopted by the GOP.

g. The new facility for the NIMRT staffed and fully functional.

h. Research and training programs at NIMRT which meet the priority needs of the GOP's Malaria Control Program.

i. Senior and mid-level health personnel trained in malaria control participating in surveillance as a regular part of their duties, including taking blood smears, administering appropriate drug treatment, and conducting periodic epidemiological analysis.

j. Health education activities expanding and achieving positive results in obtaining social acceptance of house spraying and surveillance activities.

Evaluate

1. Overall and provincial malaria situation since last evaluation September 1991, including malaria (particularly *Plasmodium falciparum*) around refugee settlements.

2. Vector control methods in use and current insecticide spray operations, with particular reference to operational criteria, spray strategy, insecticide resistance problems and use of cost effective insecticides.

3. What progress has been made in defining the current importance of the various vector species (i.e., *Anopheles culicifacies* and *An. stephensi*), especially in rural areas where there is extensive use of irrigation systems, as well as sites occupied by refugees.

4. In-country training program, health education efforts committing participant insecticides, operations research and information system as they relate to vector control spray operation.

5. Status of malaria surveillance and its integration into federal and provincial health and malaria control services.

6. Current approaches to malaria control in view of reduced donor support for insecticide supplies and other resources in future.

7. Chloroquine resistant falciparum malaria identified areas in status in province and the effectiveness of currently employed treatment regimes.

8. Manpower development activities in malaria control at district, provincial and national level.

9. Operational research activities at the NIMRT, particularly the progress of the *Anopheles stephensi* project.

Recommend

1. Improvement measures under deficient areas of each of the above.

2. Priority areas for operational research and any necessary organizational changes necessary to strengthen future program implementation.

3. Training strategy for administrative, technical and professional levels involved in future malaria control activities.

4. Methods to strengthen entomological activities with reference to recommended more effective malaria control in the future.

5. Guidelines for stratification of the country with a view to plan and develop new approaches to malaria control methods.

Participate in a one day workshop at the conclusion of the evaluation along with representatives from the MOH, DOMC, provincial MCP and USAID to assess progress and directions of the MCP.

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Annex C

Itinerary in Pakistan

August

29	DOMC, Islamabad
30	USAID and WHO, Islamabad
31	UNHCR and MOH, Islamabad

September

1	Director General Health Services Punjab, Lahore
2	NIMRT, Lahore
3	Lahore Municipal Corporation and villages
5	Field, Punjab Province
7	Director, Malaria, Sindh Province, Karachi
8	Health Department, Karachi Metropolitan Corporation Visits to health facilities, Karachi area
10	Director, Malaria, DG Health and UNHCR, Quetta, Baluchistan Province
12	Director, Malaria, North West Frontier Province, Peshawar
13	UNHCR and field, NWFP
14	Field and District Health Office, Mardan, NWFP
15	Preliminary Debriefing, USAID/HPN, Islamabad
16-20	Report writing
20	Debriefing, Director of USAID, Islamabad
21	Presentation Ceremony, MOH, Islamabad
22	Workshop, DOMC, Islamabad, and departure

Annex D

Persons Contacted

Islamabad

USAID/Islamabad

Mr. John Blackton, Director
Ms. Nancy Tumavic, Deputy Director
Ms. Anne Aarnes, Chief, HPN
Mr. Richard Steelman, Chief, PDM
Ms. Barbara J. Spaid, Deputy Chief, HPN
Dr. Rifaq A. Ismail, Project Officer, HPN
Mr. Ayub Ashley, Program Assistant, HPN
Dr. Jan A. Rozendaal, USAID/LTA (Malaria)

USAID/Karachi

Mr. A. Karim Nayani, Liaison Officer (LO)

Ministry of Health, Directorate of Malaria Control

Mr. Chaudhary A. A. Mujahid, Director
Dr. Ghulam Hashim, Epidemiologist & team member
Dr. Mrs. Shereen Assad, Medical Officer
Mr. M. Aslam, Health Education Officer
Mr. M. Noor Alam, Statistics Officer

World Health Organization

Dr. Nabel-al-Tawil, Country Representative
Dr. Ahmed Ali Abdul Latif, PHC Adviser

Commission for Afghan Refugees

Col. Dr. Altaf-ur Rahman Khan, Director Medical Services

Ministry of Health, Special Education and Social Welfare

Dr. S. Mohsin Ali, Director General and Additional Secretary
Dr. Habib-ur-Rehman, Deputy DG (Public Health)

Punjab

Punjab General Health Services, Lahore

Dr. Aftab A. Chaudhary, Director/CDC
Dr. S.M. Mohsin Abbas Naqvi, Assistant Director/Malaria
Mr. Mukhtar Ahmed Shah, Parasitologist/Malaria
Mr. M.A. Ashraf Chaudahry, Senior CDC Officer
Mr. Sana A.K. Mahmood, CDC Officer
Mr. Zaffar Ahmad, CDC Officer
Mr. Javed Iqbal Malick, Entomologist

National Institute of Malaria Research and Training, Lahore

Dr. Imtiaz Hussain Shah, Director
Dr. Muhammad Parvez Mehmood, Medical Officer
Mrs.Ghazala Nadeem, Scientific Research Officer
Mr. Rai Mushtaq Ahmad, Assist. Scientific Officer/Malaria
Mr. Iqbal Muhammad, Administrative Officer
Mr. S. D. Parvez, Assistant Scientific Officer (Entomology)

NIMRT Field Station at Chak 23, Shimali (North)

Mr. S.D. Parvez, Assist. Scientific Officer/Entomology
Mr. A. Wadood, Entomological Technician
Mr. Ghulam Sarwar, Entomological Technician

Lahore Municipal Corporation

Mr. Abdul Majid Mian, Mayor
Dr. Asad-ur-Rehman, Chief Health Officer/Urban Area/Malaria
Dr. Bilal Ahmad, Medical Superintendent/TB
Mr. Riaz Ahmad Janjua, Chief Sanitary Inspector/Malaria
Mr. Gulzar Ahamad, Entomological Technician

Outpatient Diagnostic Clinic and PCD Post, Begum Pura

Dr. Mrs. Mushtari Khanum, Medical Officer
Mr. Tarik Rehman, Laboratory Assistant

Lahore District Health Office

Dr. Khurshed A. Khan, District Health Officer
Dr. M. Nasir Bhatti, Assistant DHO
Mr. Sh: Sardar Ahmad, Assistant Entomologist
Mr. Sh: Ehsan-ul-Hug, CDC Officer
Mr. Mohammad Ashraf, CDC Officer
Mr. Talib Hussain, CDC Inspector

Rural Health Center, Chung

Dr. Izhar Hussain, Medical Officer in charge
Dr. Jamal Mehmood, Medical Officer
Dr. Mrs. Saddaf Zaffar, Medical Officer
Mr. Ghulam Rasul, Microscopist
Mr. Rashid Justan, Laboratory Assistant

Kasur District Health Office

Dr. Khalid Mahmood, District Health Officer
Dr. Ashfaq Ahamad, Assistant DHO
Mr. Iftikhar Ahamad Shah, Assistant Entomologist
Mr. Mohammad Sharif, CDC Officer

Rao Khan Wala Basic Health Unit (BHU)

Dr. Nasir-ud-Din, Medical Officer
Mr. Laceeq Ahamad, Dispenser
Mr. Mohammad Sharif, CDC Supervisor
Mr. Mohammad Ashraf, Sanitary Inspector

Sindh

Malaria Control Program, Hyderabad (at Karachi)

Dr. Ghulam Rasul Sheikh, Director (Malaria)
Mr. Sumar Sadar-ud-Din, Epidemiologist
Mr. M. Majid Khan, Senior Malaria Superintendent
Mr. Ghayyas Haider, Entomologist
Mr. Sharif-ul-Hasan, Senior Evaluator

Sindh Provincial Health Secretariat

Mr. Saeed Ahamad Siddiqui, Health Secretary

Jinnah Post Graduate Medical Center, Karachi

Dr. Mrs. Seemin Ghulamullah, Chief Casualty Medical Officer

South Karachi District Health Office

Dr. Umar Baloch, District Health Officer

Karachi Metropolitan Corporation

Dr. Capt.Sikandar Ali Panhwar, Director Health Services
Dr. A. D. Sajnani, Deputy Director General, Health Services
Mr. Altaf Hussain, Entomologist

Field Lilly Nullah and Clifton Karachi

Mr. Altaf Hussain, Entomologist
Mr. Bashir Ahmad, Entomological Technician

Baluchistan

Secretariat (Health), Quetta

Dr. Mohammad Iqbal Khan, Health Secretary
Dr. A. Rehman Khan, Director General Health

Project Director Health - Afghan Refugees, Quetta

Dr. Taj Mohammad, Deputy Director (Malaria & TB)
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Mr. S. Mohammand Asif Mangal, Microscopist

Provincial Headquarters (Malaria), Quetta

Mr. Abdul Sattar, Senior Malaria Superintendent
Mr. Mohammad Sadiq Khan, Malaria Superintendent
Mr. Ali Ahmad Khan, Assistant Entomologist
Mr. Noor-ul-lah Khan, Health Education Officer

Akhroot Abad

Mr. Ali Ahmad Khan, Asistant Entomologist

North-West Frontier Province

Civil Secretariat (Health), Peshawar

Surgeon Mohammad Kabir, Health Secretary

Provincial Headquarters (Malaria) Peshawar

Dr. Mohammad Iqbal Khan, Assistant Director (Malaria)
Mr. Abdul Aziz Khan, Senior Malaria Superintendent
Mr. Murtaza Khan, Malaria Superintendent
Mr. Fazl-e-Raziq, Entomologist
Mr. Shaukat Pervez Khan, Assistant Entomologist
Mr. Waris Khan Afridi, Health Education Officer

UNHCR (Health) Peshawar

Dr. Ahamad Elzein, Health Coordinator
Mr. Salah-ud-Din Khan, Senior Field Assistant (Sanitation)

Médecins Sans Frontiers (MSF/Holland)

Dr. Mark Rowland, Malaria Project Manager
Mr. Guy Rudland, Administrative Assistant (Malaria)
Mr. Sean Hewitt, Entomologist (Malaria)

Rural Health Center at Nhaqi

Dr. Hidayat-ur-Rehman, Medical Officer (In charge)
Dr. Abbas Ali, Medical Officer
Dr. Yasmin Mobeen, Women Medical Officer
Dr. Ghulam Rasul, Dental Surgeon
Dr. Sher Bahadur, CDC Officer
Mr. Siraj-ul-Huq, Microscopist
Mr. Salah-ud-Din, Laboratory Assistant
Mr. Abdul Rahim Khan, Assistant Entomologist (Peshawar)

Agra Vala Village

Mr. Radi Gul, Assistant Malaria Superintendent

Camp Yaka Ghund

Mr. Sabir Ahmad, Dispenser
Mr. Murtaza Khan, Malaria Supervisor
Mr. M. Rauf, Community Health Supervisor
Mr. Shahzad Gul, Community Health Supervisor
Ms. Najma Perveen, Lady Vaccinator

Sheikh Yousef Basic Health Unit (BHU)

Mr. Sahibzada Khan, Medical Technician
Mr. Khadim Khan, Medical Technician
Mr. Gul Mohammad, Microscopist
Mr. Ghulam Mohammad, Malaria Supervisor
Mr. Khush Hal Khan, Assistant Malaria Superintendent
Mr. Sher Afzal, EPI Technician

District Health Office (Mardan)

Dr. Indor San Rajpal, District Health Officer
Mr. Mohammad Anwar, Malaria Supervisor
Mr. Rahim Khan, Administrative Officer
Mr. Dilawar Khan, Senior Microscopist
Mr. Mohammad Nasim, Assistant Malaria Superintendent
Mr. Kachkol Khan, Assistant Malaria Superintendent

Annex E

Establishment of Malaria Micro-stratum Profiles

Introduction

The use of insecticides has been drastically reduced since the beginning of the program. Only 1400 MT of malathion will be utilized in 1992 and 1000 MT have been purchased for 1993. No further purchases of insecticide are being contemplated by A.I.D. and at the moment no other donor has been identified. In all likelihood additional insecticide purchases will have to be made by the GOP.

To further reduce the reliance on insecticide for residual spraying of houses, better use will have to be made of epidemiological, entomological, hydrological-geological and climatological information. This proposed study may assist the DOMC to reduce the use of insecticides by refining the strategy of focal spraying.

Although the work is time consuming, especially at the peripheral level, there should be little expense, especially of foreign exchange, involved. The work may require improved GR, obtaining specialized maps, and climatological information as well as location of malaria cases. The majority of record keeping would be done at the village level by assistant entomologists but the information would be analyzed by the DOMC or NIMRT.

Basic Requirements

a. Initial selection of areas would be restricted to rural foci of high malaria endemicity;

b. Only foci-localities with good climatological records and acceptable entomological information will be selected;

c. Past and current GR data and maps will be utilized to identify malaria cases and vector breeding sites;

d. The sample size will be based on the BHU or village depending on staff and information available; and

e. Water logging data proposed by Dr. Rozendaal should be included.

Information Required

Ecological-Environmental: Paradigm type

1. Irrigated agriculture, especially those showing a high degree of waterlogging

2. Plains-traditional agriculture

3. Coastal plains

4. Mountain valleys

Hydrological

1. Can annual transmission be determined from changes in ground water tables reported twice a year since 1985 by the SMO.

Climatological

1. Can annual transmission be determined from deviations of 10-year rainfall data reported biweekly or monthly

2. Can annual transmission be determined from deviations of 10-year maximum-minimum temperature reported biweekly or monthly

Village - Basic Health Unit

1. Availability of staff and transport

2. Availability of private drug dispensers with adequate supplies of anti-malaria drugs

3. Availability of past GR-Epidemiological data

4. History of malaria cases

5. Condition of local population

   a. Stable population
   b. Seasonal work related to migration
   c. Unstable - migration annually

Epidemiological

1. Species and ratio of malaria found

2. Annual transmission rate of each species

3. Annual variation of transmission of each species

4. Seasonal patterns of transmission

5. Patient age, sex, and occupation

6. Afghan refugees

Household survey

1. Are malaria cases scattered or clustered

2. If clustered, is the annual pattern similar or different (locate houses on GR maps)

3. If clusters vary, is there a relationship to vector breeding sites

4. If clusters are similar, is there a relationship to vector breeding sites

5. Relationship of case location to index case (include history of index case, if known)

Entomology

1. Species involved: *An. culicifacies*, *An. stephensi* and others

2. Distribution and density of each species

3. Insecticide resistance tests/results

4. Breeding sites: mapped

   - identifiable primary sites; size and type
   - sites in relation to known cases
   - sites in relation to water storage - agriculture

5. Can mosquito densities be correlated to ground water table and salting

Possible Control Strategy

Random case distribution

1. utilizing existing strategy depending on village size and species of *plasmodium*

2. Clustered cases with unknown primary vector breeding site or extensive breeding sites (agriculture - river basin)

3. utilizing existing strategy with emphasis on focal spray

4. attempt to define breeding sites for possible larviciding or environmental management

5. health education to promote personal protection measures

6. Clustered cases with clearly defined primary breeding sites

   A. identify breeding sites and treat according to type, size, and distribution

   - environmental management
   - source reduction lower ground water table and flush saline from soil
   - larvicide: chemical/biological

   B. highly selective residual spraying of houses (foci) in cluster areas

C. personal protection measures

- insecticide impregnated bednets
- screening of windows and doors
- insecticide impregnated curtains

As in C (above) but with limited number of breeding site in dry season and extensive sites in wet season.

1. Treat breeding sites during dry season where practical

2. Improve PCD and ACD with better microscopy in clusters

3. Improve health education aimed at achieving complete treatment and self protection.

4. Selective vector control at right time in clusters only. (Control early in the mosquito breeding season could be considered)