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MALARIA CONTROL IN MALAWI

by

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Introduction

Dr. Chin was the USAID representative on a joint Government of Malawi/ WHO/UNICEF/USAID team that conducted a comprehensive review of Malawi's National CDD/Malaria Control Programs June 5-25, 1989. The objectives of the review were:

- To examine diarrhea and malaria activities in Malawi and assess the degree of success in achieving the established goals.
- To identify operational and technical problems regarding CDD/Malaria strategies in Malawi.
- To recommend possible solutions to optimize the implementation of CDD/Malaria strategies.
- To develop guidelines for a plan of operation for the period 1990-1994.
- To prepare a written report of the recommendations for the consideration of the Ministry of Health.

The review team was composed of twenty-two nationals and six international members representing WHO, UNICEF and USAID (team members are listed in Annex 2). The team was divided into five groups composed of one international member and four nationals, with regional staff to facilitate field activities. In total, the review teams visited and evaluated CDD/Malaria activities in:

2 major hospitals
1 general hospital
16 district hospitals
30 health centers
870 households with children younger than 5 years of age

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*The team's report was not available at the time this report was completed. The recommendations in this report, which was written for USAID as part of Dr. Chin's consultancy for the VBC Project, also will be included in the team's final report, which will be available from the Ministry of Health and the WHO Sub-Regional office in Harare, Zimbabwe.

Malaria Control in Malawi

Malaria infection rates in Malawian children are generally considered to be greater than 50 percent (hyperendemic malaria). Most symptomatic infections are in children younger than five years of age and are due to Plasmodium falciparum, the most malignant form of human malaria.

The economic burden caused by this infection, reflected in just the number of patients with malaria who seek treatment at outpatient and inpatient facilities, is enormous. The major causes of morbidity and mortality in young children as reported to the Ministry of Health (MOH) during 1988 are presented in Table 1 (Annex 1). As indicated, malaria was the major cause for visits to outpatient facilities by children younger than five, accounting for 35.8 percent of the total visits. In the same age group, malaria was responsible for 30 percent of all hospital admissions and 19.4 percent of the reported deaths. If these rates are combined with those due to anemia, which is generally considered to be malaria-related, the results are even more striking. They show that together, malaria and anemia cause 54 percent of all outpatient visits, 43.1 percent of hospital admissions and 31.8 percent of the deaths.

Perhaps of even greater concern is the fact that the 1988 rates represent a significant increase over the past several years in morbidity and mortality caused by malaria in children younger than five. A comparison of the MOH data from 1985 with the most recent 1988 data shows the following:

- 43% increase in hospital admissions
- 85% increase in hospital deaths
- 30% increase in malaria case fatality rate

The central objective of the proposed Promoting Health Intervention for Child Survival (PHICS) project is to promote health initiatives to enhance child survival. It is obvious that in order for this project to succeed, a major concentration of USAID assistance must be invested in an effort to reduce the primary cause of childhood morbidity and mortality, infection with falciparum malaria. Hence, the balance of this report will focus on recommendations for developing a strategy to meet this long-term need.

Planning considerations

Those responsible for planning projects to reduce mortality and morbidity due to malaria in Malawi must take into account the following imperatives:

1. Long-term needs must be anticipated.

The severity of the malaria problem is inversely related to a country's

level of socio-economic development. Thus, malaria control planning must be based on meeting long-term needs by using methods that are not only effective but also affordable within national resources of funding and manpower.

2. A long-term solution depends on improvement in socio-economic status.

Current methods available to control malaria, although imperfect, are effective provided they are properly selected and applied on a persistent or even continuous basis. Reducing malaria transmission on a more permanent basis would require a favorable shift in the epidemiologic balance of the disease, which generally follows changes in human behavior and improvements in human ecological/environmental conditions. As an example, malaria as a public health problem in the southern United States finally began to recede and then disappeared by the late 1940s because of improvements in housing, water supply, disposal and access to medical care for the rural population.

3. Difficult technical problems must be anticipated.

Attempts to control malaria in this part of the world must be based on an understanding of the virulent manifestation of falciparum malaria. While the precise reason for the severity of the local falciparum malaria is not known, it is reasonable to suggest that the malignant nature of the disease is most likely due to the efficiency of the local mosquito vectors rather the virulence of the parasites. Because of their efficiency, local vectors are able to inoculate massive numbers of parasites, which may overwhelm the patient's natural immune mechanism and cause a fatal outcome. From another perspective, because of the high infection rate in such mosquito populations, only a few bites per night are sufficient to ensure infection of local residents. Given these characteristics, controlling malaria transmitted by the local mosquitoes is far more difficult than it is in other areas where the vectors are less efficient.

The intractable nature of the malaria problem in Africa was recognized by the father of malariology shortly after he discovered the mosquito's role in the malaria parasite's life cycle. During the first visit to Africa following his epic discovery nearly a century ago, Sir Ronald Ross made the following observation, which remains just as valid today:

> "The immense and fertile tract of Africa, what we call the Dark continent, should be called the Malarious Continent, and for centuries, the successive waves of civilization which have flooded and fertilized Europe and America, have broken themselves in vain upon its deadly shores."

Another factor, which may be primarily responsible for the recent increase in virulence indicated by the rise in infant mortality due to falciparum infections, is the high prevalence of local strains that have developed resistance to chloroquine. Experience from Southeast Asian countries, in particular, indicates that an unusual increase in the death rate due to falciparum malaria is usually related to the development of chloroquine resistance to its highest level (R III), at which point the parasites become refractory to treatment with the drug. In fact, results from the most recent studies available, performed some three years ago in Malawi, indicate that the proportion of strains at the R III resistance level had already reached nine percent of the infections assessed.

Current malaria control strategy

Since the 1970s, malaria control in Malawi has been based solely on the use of anti-parasitic interventions, mostly because of the availability of the inexpensive and effective drug chloroquine. With the confirmation of the presence of chloroquine-resistant strains by 1984, this strategy was modified in order to reduce the resistance-selective pressure on the parasite by discontinuing chloroquine prophylaxis in young children. Because pregnant females were considered particularly susceptible to malaria infection, chloroquine prophylaxis coverage of this group was continued. In addition, a plan was implemented to use alternative drugs to treat those cases that might not have responded to chloroquine.

Malaria control program administration

Technically, a discrete malaria control program does not exist in Malawi. At the national level, there is the chairman of the National Malaria Control Committee and a manager whose duties are divided between the programs of malaria control and diarrhea control.

Malaria program implementation has been completely integrated into the Primary Health Care (PHC) Service. The primary responsibility of the National Malaria Control Committee seems to be issuing periodic program guidelines. It may be possible to integrate the operational element with the PHC service in most disease control programs, but research, training and evaluation should be retained as distinct components of a malaria control program.

Recommended changes to current malaria control strategy

With the continued evolution by the parasites to develop higher degrees of chloroquine resistance and ultimately to evolve resistance to alternative antimalarials, the MOH will have little choice but to consider the use of feasible and effective alternative malaria control methods, including anti-

vector measures, to supplement the current anti-parasitic strategy. While the need for such a strategy change is clear, it is equally obvious that anti-vector methods cannot be used cost-effectively until baseline data on mosquito ecology, bionomics and behavior are available to guide the selection of anti-vector measures. Therefore, the MOH must view gathering such data as a matter of the highest priority. The MOH should therefore obtain the services of an entomologist consultant experienced in vector monitoring methods to begin the vital field surveys as soon as possible. At the same time, the MOH should assign at least two of its personnel with some laboratory experience to assist the consultant and learn the basic entomologic field techniques.

To meet longer-term needs, the MOH may wish to request the services of one or two U.S. Peace Corps Volunteers with training in medical entomology to work with the newly trained MOH employees to continue and extend monitoring activities. Ultimately, however, the MOH must develop its own competence in medical entomology through appropriate in-country training and subsequently by selecting suitable candidates for long-term training abroad (M.Sc.).

Immediate changes needed in the control strategy

In view of the marked rise in childhood mortality due most likely to an increase in the prevalence of chloroquine-resistant falciparum malaria, the MOH should consider making the following changes in its present malaria control strategy as rapidly as possible:

a. Redeploy the drug resistance monitoring teams, which were used successfully three years ago, to update the current resistance status with emphasis on the prevalence of strains with R III resistance.

b. Extend the availability of chloroquine at the community level through the services of village volunteers to be selected, trained and supervised by the Health Surveillance Assistants (HSAs). It is very important that chloroquine be available to every family regardless of ability to pay. It would be a tragic mistake if a free distribution policy was not adopted because children whose families could not afford the 10 or 15 tambalas ($0.04 - 0.06) to pay for the chloroquine would die needlessly.

c. If the results from the updating of chloroquine resistance show that the prevalence of R III resistance strains is 20 percent or higher, the MOH should consider substituting amodiaquine for chloroquine as the primary drug to treat all suspected malaria cases in children younger than five. In such cases, if clinical laboratory findings continued confirm drug failure, the next treatment should be with Fansidar.

d. Develop a system for continuous monitoring of a) drug resistance and b) symptomatic versus asymptomatic malaria.

Currently, the degree of drug resistance and amount of symptomatic versus asymptomatic malaria are not known with a sufficient degree of precision to enable greater efficiency in program strategy development. Special operational research teams must be trained and deployed to gather such information, usually on an infrequent basis. As an example, the last updating of monitoring studies to assess drug-resistant malaria was some three years ago. In the meantime, childhood mortality continued to increase due to causes that can only be speculated since more precise data are unavailable. A simple system for continuous monitoring of important parasitic/operational parameters is proposed:

Select five health units, three in lowland areas and two in the highlands, to function as sentinel posts. Major requirements in site selection would include: enthusiasm of facility staff to support monitoring activities and the availability of space to house a small laboratory for staining and examination of blood smears. A young female from the area of the post would be selected and provided training in malaria microscopy. The number of microscopists required per post may be estimated on the basis of one per 2500 outpatients visits/month at the health post. After training, the microscopist's assignment would be as follows:

1. Take blood smears from all the fever cases, stain and examine to provide results to clinical officers before the patient is examined and treated. Treatment would be based on clinical findings as well as blood smear results.

2. One day per month, preferably the first day of the month when possible, take a blood smear from everyone reporting for care. These smears would be stained and examined during the remainder of the month as time is available.

3. Modify the record-keeping system to enable the identification of treatment failures of malaria cases.

Information provided by conducting these three procedures would allow continuous monitoring of the following events:

1. The proportion of fever cases that are smear-positive for malaria.

2. The approximate rate of drug resistance and, more importantly, the rate of R III resistance.

3. The rate of asymptomatic parasite carriers.

4. The gametocyte rate in those whose smears are positive.

For this simple system to work would require the creation of five malaria microscopy posts and the provision of 5-10 microscopes, a modest investment considering the value of results.

After one year of operating this system, it would be possible to compare the relative cost of arbitrarily treating all fever cases as malaria with the more specific treatment of cases confirmed by blood smear. Such a comparison would take into account the cost of the unnecessary antimalarial usage versus the cost of the microscopists' salaries.

In addition, each health facility that has a laboratory with the capability to examine blood smears to detect malaria parasites should be encouraged to optimize the use of this procedure to assist in the clinical diagnosis of malaria. The team recognizes that, given the present resources, laboratory technicians cannot be expected to increase the examination of blood smears by any significant number and the ultimate solution must await the development of a new category of personnel, the microscopist. For now, however, the MOH should ensure that at least well-functioning microscopes are available in all of the laboratories.

e. Given the fact that no clear guideline exists to assist the clinical officers in providing optimal management of critically ill patients with malaria or in the treatment of drug-resistant malaria, the MOH should consider collaborating with the Queen Elizabeth Hospital (Liverpool School of Tropical Medicine group) and the Mangochi Malaria Research Project (MMRP) to produce video cassettes illustrating how such cases should be treated.

In addition to the video cassettes, brochures containing the same specific guidelines should also be printed and distributed.

Alternative control methods to be considered

1. Evaluating the use of primaquine as an anti-gametocyte agent

Primaquine is a drug well known for its ability to destroy gametocytes, the malaria stage responsible for infecting mosquitoes (chloroquine lacks this ability) and also for its toxic potential (intravascular hemolysis) in individuals whose red blood cells are deficient in the enzyme glucose-60-phosphate dehydrogenase (G-6-PD). It is believed that some 10 percent of African

blacks have a deficiency of this enzyme. It is also thought that rendering the gametocytes non-infectious is a waste of drug in the African context because the cured patient will soon be reinfected. Because of these two factors, the use of primaquine as a single-dose treatment of 30 mg (adult equivalent dose) to destroy gametocytes has seldom been considered. It is not known whether this single-dose treatment would lower the malaria transmission potential if it were incorporated into the standard treatment for falciparum malaria. The probability is that if primaquine were made available to treat a significant proportion of the infected population, there would be a detectable reduction in transmission potential. It is suggested, therefore, that the MMRP conduct a small-scale trial to assess the efficacy, acceptability and safety of this single-dose treatment.

The fear of primaquine toxicity, particularly in blacks who are deficient in G-6-PD, may be unwarranted because the toxic reaction is generally related to the standard 14-day primaquine treatment against relapsing malarias such as P. vivax and not to its use as a single-dose anti-gametocyte agent.

2. Use of anti-vector measures

Guided by entomologic monitoring data, the following intervention measures may be considered for small-scale trials to determine their efficacy, acceptability and cost:

a. House spraying with DDT

If entomologic assessments indicate that the local vectors are susceptible to DDT and that they also rest predominantly indoors following the taking of a blood meal, a small-scale trial of indoor house spraying with DDT (WDP 75%) at a dose of 2 gm/m^2, should be undertaken in several villages. Such a trial would be carried out with the supervision of a consultant entomologist who would train the spraymen and supervisors and select appropriate localities to act as controls.

The spray operations should be timed to begin at the start of the rainy season and just prior to the expected rise in malaria transmission (Nov.-Dec.).

In a recent evaluation of the Malaria Control Program in Swaziland, Dr. Russell Fontaine concluded that such house spraying with DDT was effective in controlling malaria and that this control method was more cost-effective than the anti-parasitic method of case detection and treatment. Based on his 1987 findings, the average cost of spraying one house was estimated to be approximately U.S.$0.68 per round of spray. Assuming seven individuals live in one house and each house is sprayed twice a year, the per capita cost is reduced to U.S.$0.19, a sum equivalent to the cost of chloroquine to treat six to eight episodes of fever/malaria

in a young child in Malawi or approximately only one-half of the fever/malaria attacks in an average child per year.

b. Measures to minimize or avoid man-mosquito contact

Traditionally, ways to minimize man-mosquito contact have included the use of bed nets, screening of house windows and doors and the use of repellents. Various small-scale trials using bed nets impregnated with pyrethroid insecticides, usually permethrin, have been completed recently in Africa (The Gambia, Kenya, Tanzania). In these trials, impregnated bed nets were effective in reducing man-vector contact and transmission. However, effectiveness is dependent on constant use and often requires a change in behavior if the population is not accustomed to using bed nets. The initial costs of bed nets is often high (about $25), but WHO has identified cheaper sources in Asia and the cost may be reduced to $5 to $10 on bulk purchases. Insecticide for impregnation is relatively cheap (about $0.50/six months) and safe to use. Social marketing and community participation through health education are required to make such programs effective and sustainable. Efforts in the trials mentioned above have resulted in good community participation in most areas.

WHO recently issued a comprehensive review on the use of bed nets (Rozendaal, J.A. 1989/WHO-VBC-09-965) and copies are available through A.I.D.'s VBC Project.

There are also other ways to minimize or avoid mosquito bites that should be evaluated in Malawi. These include impregnating various cloth materials, items of clothing, curtains and drapes with preparations that have long residual effectiveness in repelling and killing of susceptible mosquitoes.

c. Larviciding/source reduction methods

Given the ubiquitous nature of vector breeding sites during the wet season, there is agreement that large-scale use of anti-larval methods would not be an effective means of control. However, an evaluation of the development of breeding sites during the dry season may disclose that the countless number of sites previously present may have contracted to a few, making implementation of anti-larval measures feasible. If additional studies confirm that the limited number of dry-season breeding sites are primarily responsible for the seeding of the temporary sites when the rains come, it may be possible to reduce larval densities during the dry season and thereby limit their proliferation during the wet season. In general, larviciding can be effective when applied to well-defined breeding sites within the mosquito flight range of human settlements. Identification and treatment of such sites can also be effected through community participation.

Development of local expertise in malariology

Taking the long-range view, the selection of effective and affordable methods to control malaria can only be made based on adequate knowledge of the local epidemiological conditions. The future success of the Malaria Control Program will also depend on its ability to remain flexible and change control methods as required to keep pace with the evolutionary changes in the parasite (drug resistance development) and the vector. Local technical expertise in malariology must be developed in order to meet these requirements.

Continuous monitoring of the epidemiological dynamics of malaria transmission requires the deployment of a staff that is well-trained in malaria operational research. Such personnel are few, but Malawi is fortunate in that the core structure of an operational research unit already exists in the Mangochi Malaria Research Project (MMRP). Given the certainty that the problem of drug-resistant falciparum malaria will worsen considerably in the not-too-distant future, the MOH must take steps now to augment the present focus of the MMRP on the malaria parasite and its effect on young children and pregnant females to include basic studies of the local vectors and their ecology, bionomics and behavior. Only with a more precise understanding of the habits of the vector can possible weak links in its transmission cycle be exploited and alternative methods of malaria control be developed.

Reorientation of the MMRP

The MMRP is currently being operated as a joint project by the MOH of Malawi and the U.S. Centers for Disease Control (CDC) with funding from USAID. The MMRP, as presently constituted, is scheduled to terminate at the end of June 1990.

Professional leadership at the MMRP is currently being provided by a staff member of the Malaria Branch, CDC. In order to be a local institution and serve the pressing health needs of Malawi, the MMRP must ultimately be staffed at the professional level by Malawians who are employees of the MOH.

The development of a self-reliant national research unit with expertise to conduct the full range of malaria operational research should be the immediate mission of an expanded MMRP. In addition, this unit should take on the responsibility for developing malaria training curricula for use at various levels, including schools, as soon as possible. From the core of national expertise in malariology to be developed, the MMRP can evolve into a center to study other vector-borne diseases in addition to malaria in the near future. Alternatively, depending on the priority objectives of the MOH,

the intermediate goal of the MMRP may be to continue assessments of other intervention methods to promote child survival. Ultimately, however, the MMRP has the potential to develop into the CDC of Malawi. This should be its long-term objective.

Successful conversion of the MMRP from a research institution led by foreign scientists to one that is totally self-reliant will require a maturation time measured in decades. Close linkage with an established sister institution will be essential during the developmental period. Fortunately, such a linkage already exists between the MMRP and CDC. To assist the MOH in the development of an independent, productive MMRP, the following activities are suggested along with appropriate time frames:

1. USAID commitment to develop a national MMRP should be firm and of long duration, lasting at least 10 years.

2. During the first five years, the operation of the MMRP should remain essentially unchanged. Its physical facilities, however, should be increased to at least three times their present size to accommodate an office and an entomological laboratory in addition to the existing microscopy lab.

USAID may wish to consider recommending to the MOH that a Technical Advisory Committee (TAC) be formed to oversee MMRP operations, set policies and coordinate assistance among external donors. Such a TAC would have representation from the MOH, CDC and USAID and perhaps an outside impartial consultant as well.

Recruitment of qualified candidates to fill professional positions after they have received long-term training should be a high priority for the MOH. When possible, such candidates should be individuals who are already associated with the Malaria Control Program, including the current members of the MMRP. Such a policy would maximize these individuals' chances for career development in the field of malariology.

1. **Malariologist to be director, MMRP**: training should include an MPH in epidemiology. Following formal training, the candidate should attend the WHO-sponsored course on malaria control for senior professionals. This is a three-month course given annually from January to March.

2. **Entomologist**: MS in medical entomology followed by practical field training, which is available through the WHO\TDR courses at the University of Jos in Nigeria or the University of Abijan in Côte d'Ivoire.

3. **Laboratory Coordinator**: MPH with emphasis on Public Health Laboratory Practices.

4. **Training Coordinator**: MA in social anthropology and short-term (1-3 months) additional health education training at the CDC.

Following completion of training, the Malawian professionals should work closely with their counterparts for one additional year. Once the national professional staff was in place, the MMRP's ties to the CDC would consist of short-term exchange of professional staff in both directions to collaborate on studies and attend training courses.

During the early development years, the MMRP, with USAID support from its regional office, should take a leading role in organizing or sponsoring annual seminars and conferences to review malaria and other vector-borne disease regional control and research activities in order to coordinate and exchange information. One or two outside consultants may be included to provide a current, global perspective on vector-borne disease problems.

The continued support of USAID during the latter half of the 10-year plan would be essential, particularly to provide the type of resources that national governments have traditionally been reluctant or unable to provide. These include funding to support travel to attend scientific meetings, regional/international training courses, subscription to scientific journals and updated reference text books and other continuing education activities, replacement of worn vehicles and procurement of equipment. By this stage in MMRP's development, its professional staff would be able to seek research grants to help offset some of these costs. The process of phasing in the transfer of all MMRP staff to be MOH employees should also begin during this period.

Development of competence in epidemiology

In a country such as Malawi, the development of epidemiologic competence can best be promoted through close linkage to disease control programs. Given the shortage of well-trained personnel, the proposal to create epidemiology units within the MOH and at regional levels to be filled by candidates trained in this discipline would likely represent an inefficient use of scarce resource. It would be more useful to provide epidemiology training as part of a comprehensive long-term training program to develop future directors of major disease control programs. Part of the training should emphasize the classical use of the epidemiologic method in organizing a disease control program, one that has at least the following components:

1. Research
2. Policy development
3. Implementation

4. Evaluation/monitoring
5. Training

Once this initial cadre of well-trained disease control directors fully appreciates the relevance of epidemiology to disease control, it may be proper to consider creating epidemiologic units.

Training and deployment of health surveillance assistants (HSAs)

The MOH must rely on the HSAs if disease control strategies are to be implemented effectively. In addition, encouraging feedback from HSAs may help identify weaknesses in disease control plans. Thus, the HSA may be the most important link between the community members and the MOH and its various service delivery arms. With this in mind, the MOH may wish to consider the following suggestions:

1. Set the qualification of candidates sufficiently high in order to select the best educated.

2. From the very outset, every effort should be made to make the HSA position prestigious and sought-after. If a uniform is a sign of prestige in the local context, uniforms should be provided and replaced annually. If the military way of life is admired locally, some of its elements, esprit de corps and discipline may be incorporated into the HSA service. Each HSA's bicycle should be painted distinctively to identify him from afar as a HSA and he should be given sufficient allowance for repair and maintenance of the bicycle.

3. Provide adequate training emphasizing the two or three most important causes of infant mortality and morbidity. The training should emphasize effective methods HSAs can use to impart health education and motivate village leaders and community members. Culturally appropriate health education materials should be developed for HSAs to use in their work.

4. The HSAs' responsibilities should be well-defined and they should have set schedules that enable them to cover assigned areas once a month. In communities where there are village health volunteers, HSAs should take special interest and time to visit and supervise them and to replenish their chloroquine and ORS packets. In areas where such volunteers do not exist, the HSA should select and train them to assist in malaria and diarrhea disease control.

5. The HSA should be closely supervised by his supervisors, with at least one supervisory visit per month. During these visits, good work should be noted and deficiencies corrected on the spot.

6. Once per year, all the HSAs in the district should be convened. Prizes or certificates should be awarded to those identified as having performed their duties in a superior manner. Discussions should be held to encourage a free exchange of views, particularly on how implementation of health intervention measures might be improved. Such a meeting would also provide an opportunity for refresher training.

Creation of a new position, malaria microscopist

Currently, the vast majority of the malaria cases are diagnosed clinically and, in most instances, fever due to any cause is treated as malaria. As long as malaria transmission remains at the hyperendemic level (50 percent infection rate or higher in children), such a practice may be justified. If, however, malaria endemnicity is reduced significantly as a result of using more effective control methods, the proportion of the population with fever due to malaria should drop dramatically, while the amount of background fever due to other causes should remain essentially unchanged. Under such circumstances, the continued practice of treating all fever cases as malaria would result in a significant waste of chloroquine.

According to a 1985 WHO report, Malawi had the second highest chloroquine utilization of all countries under the WHO African Region (more than 118 million tablets used). Assuming that the present usage does not change (a conservative estimation), and further assuming that as a result of house spraying with DDT, the prevalence rate is reduced to less than 10 percent, this would mean that more than 90 percent of the chloroquine would be dispensed unnecessarily, a waste of some 106 million tablets, or more than U.S.$1 million. Even at present,if we assume the unnecessary use of chloroquine to be 50 percent, this would represent a waste of a sum sufficient to employ more than 1,500 microscopists for one year.

Currently, hospitals with laboratories are the only facilities where it is possible to diagnose the presence of malaria parasites by a blood smear examination. As malaria endemnicity decreases due to more effective control measures or to the favorable shift in transmission dynamics, the need to base the diagnosis of malaria on the results of a blood smear examination becomes greater. Even now, the availability of microscopy capability would greatly facilitate the identification of drug-resistant strains and thereby ensure proper treatment. In anticipation of meeting this need in the future, the MOH should support the establishment of the suggested sentinel posts to be staffed by microscopists whose sole responsibility would be the preparation, staining and examination of blood smears.

After approximately one year of experience, the MOH should evaluate the implications for more wide-scale use of microscopists. It should consider the

greater efficiency in malaria diagnosis and cost-effectiveness, compared to the wastage of antimalarials through continued use in treating all fever cases, of which no more than about 50 percent may be due to malaria.

Annex 1

Major Causes of Morbidity and Mortality in Malawian Children Younger Than Five

Table 1. Major Causes of Morbidity and Mortality in Malawian Children Younger Than Five in 1988 as Reported to the MOH

	Outpatients		Inpatients			
	Number of Cases	Percent of Total	Number of Cases	Percent of Total	Number of Deaths	Percent of Total
Malaria	1,700,734	35.8	25,155	30.0	1,544	19.4
Anemia	865,342	18.2	10,997	13.1	983	12.4
Pneumonia	326,321	6.9	9,574	11.4	958	12.1
Measles	326,823	6.9	5,900	6.6	542	8.0
Diarrhea	323,372	6.8	6,301	7.5	637	8.0

Annex 2

CDD/Malaria Review Team, June 1989

Consultants

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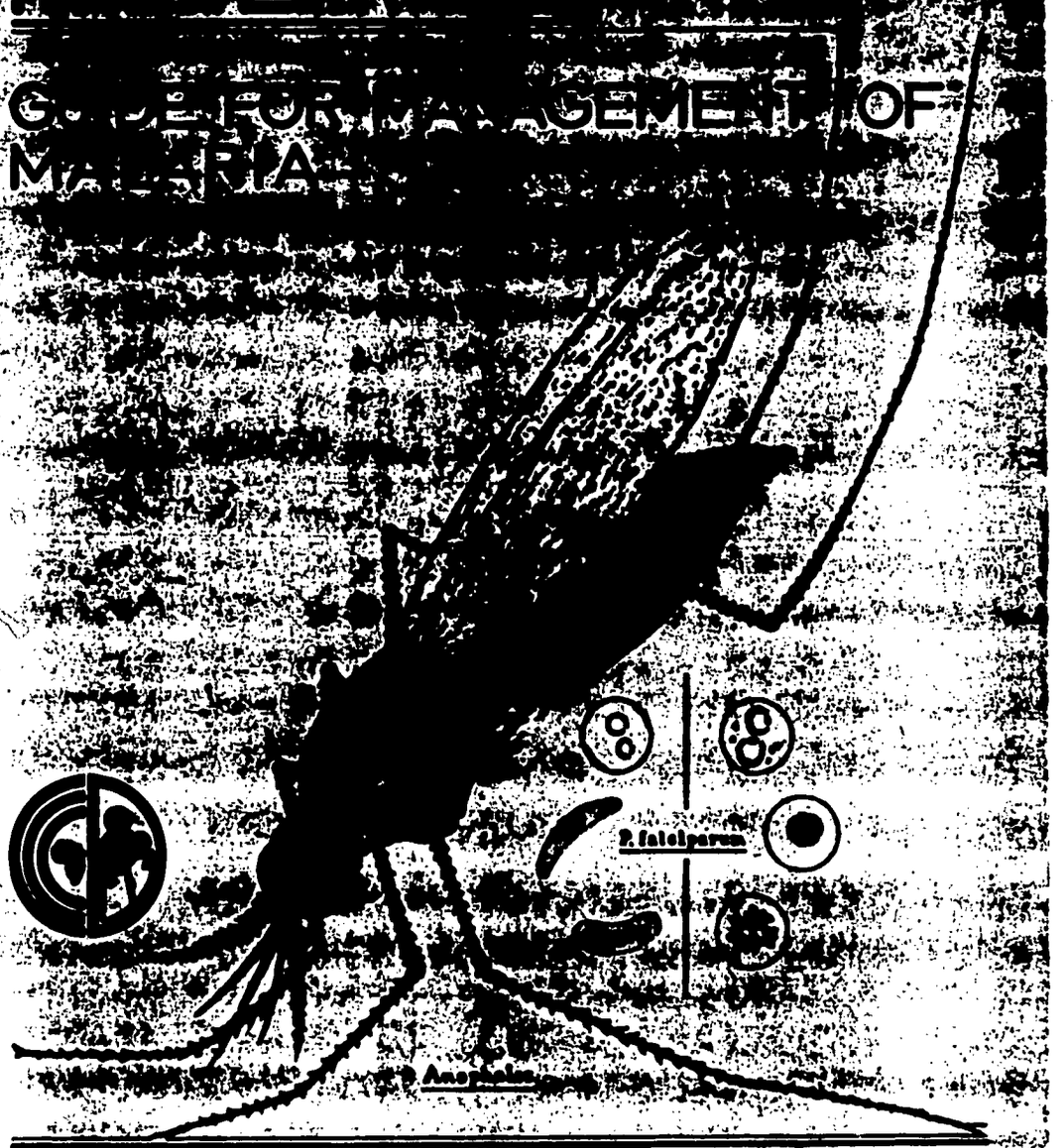
Annex 3

Guide for Management of Acute Falciparum Malaria

This guide was prepare by the Malawi Ministry of Health in collaboration with CCCD/USAID and WHO. Copies are available through the Vector Biology and Control's Vector Control Information Center, 1611 N. Kent Street, Suite 503, Arlington, Virginia 22209, USA.

MANAGEMENT OF MALARIA



FOR PHYSICIANS, CLINICAL OFFICERS, MEDICAL ASSISTANTS AND SENIOR NURSING STAFF

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