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Malaria Control in Ghana

Plan of Action

Accra, Ghana, 26 April, 1989

by

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Table of Contents

		Page
	Executive Summary	1
1.	Introduction	3
	1.1. Scope of project	3
	1.2. Ghana malaria control policies	4
2.	Malaria Assessment	5
	2.1. Method of assessment	5
	2.2. Geographic and demographic assessment	5
	2.2.1. Geographic data	5
	2.2.2. Demographic data	8
	2.3. Health sector resources	9
	2.3.1. GOG health resources	9
	2.3.2. Other providers of health care	11
	2.3.3. Health care coverage	11
	2.3.4. Health facilities	12
	2.3.5. Health personnel	12
	2.3.6. Pharmaceuticals	13
	2.3.7. International donor support	13
	2.4 Health information system	13
	2.5 Malaria	14
	2.5.1. Epidemiology	14
	2.5.2. Treatment and diagnosis	16
	2.5.3. Drug response to P. falciparum	17
	2.5.4. Entomology	18
	2.5.5. Past and current malaria control activities	18
	2.5.6. Knowledge, attitude and practices	19
	2.5.7. Operational research	20
3.	Objectives and Strategies	21
	3.1. Objectives of malaria control	21
	3.2. Strategies to meet the objectives	21

C

4. Plan of Action 22

4.1. Prompt and effective treatment of malaria 22

4.1.1. Definition of malaria cases 22
4.1.2. Diagnosis and referral for malaria 22
4.1.3. Standardization of therapy 23
4.1.4. Access to effective therapy 23
4.1.5. Laboratory diagnosis of malaria 23

4.2 Monitoring of antimalarial drug efficacy 24

4.2.1. Surveillance of therapy failures 24
4.2.2. In vivo testing 25

4.3. Training 25

4.4. Health education 26

4.5. Surveillance of malaria 26

4.6. Operational research 27

5. Monitoring and Evaluation 28

5.1. Indicators 28

Annexes

A. List of persons consulted 31
B. Simple fever protocol 32
C. Referral diagram 34
D. Algorithm for treatment of malaria 36
E. Standardization of malaria therapy 38
F. Tables 42
G. Documents consulted 48
H. Breman JG, Campbell CC. Combating severe malaria in African children. Bull WHO 1988; 66:611-620. 51
I. Slooff R. The control of malaria vectors in the context of health for all by the year 2000 strategy. J Am Mosquito Control Soc 1987; 3:551-555. 52

Acronyms

A.I.D.	Agency for International Development
CHAG	Church Hospitals Association of Ghana
GOG	Government of Ghana
KAP	Knowledge, attitudes and practices
MCH	Maternal and child health
PHC	Primary health care
TBA	Traditional birth attendant
USAID	U.S. Agency for International Development
VHW	Village health worker
WHO	World Health Organization
MOH	Ministry of Health
ORT	Oral rehydration therapy
ORS	Oral rehydration solution
CQ	**Chloroquine**
CRPF	Chloroquine-resistant P. falciparum
DMS	Director of Medical Services
CFR	Case fatality rate

Executive Summary

In Ghana, malaria is the leading cause of death and illness among children younger than five, and accounts for more days of healthy life lost at all ages than any other disease. Malaria places a heavy burden on the limited health delivery services available in the country. Almost half of all visits to outpatient facilities are due to malaria, compared with only eight percent due to diarrheal disease, the second leading cause for patient visits. Half of the hospitalizations of children under 5 years of age are for treatment of severe malaria. This leaves inadequate resources to deal with other health problems.

Treatment practices and utilization of drugs for malaria are chaotic. The first-line treatment for malaria is herbal medicine or other traditional methods. Less than half of children with fever receive any antimalarial drugs. Many different drugs are used, if at all, in a wide variety of doses and packaging, resulting in a lack of any standardization of malaria treatment.

Until recently, Ghana has not considered malaria a priority among diseases to be controlled, in contrast to many other countries in sub-Saharan Africa. Malaria is not even included in the six targets of Primary Health Care. Interest in malaria was stimulated only recently when an outbreak of "go-slow disease" (possibly malaria) occurred in 1987 and a few cases of P. falciparum malaria were reported with reduced sensitivity to chloroquine treatment. Consequently, a seminar was held on malaria on March 15 and 16, 1989. The Ministry of Health (MOH) has initiated discussions to develop a national plan for malaria control.

The objectives and strategies of the future national plan are not known. The central objective of the plan must be to reduce the mortality due to malaria. Achievement of this objective will be possible only with a national commitment, a clear, rational strategy, good intersectorial collaboration, and with assistance of multi- and bilateral agencies. A.I.D. can provide the essential leadership, guidance and assistance needed for the development and implementation of a rational, effective program to control malaria. No other agency currently provides any assistance to Ghana for malaria control.

It is recommended that A.I.D. include malaria control in its family planning and child survival project. The malaria situation in Ghana necessitates that the main objective of malaria control be reducing mortality due to malaria. Achieving this objective will require several inter-dependent strategies: 1) ensuring prompt, effective treatment of malaria in high risk groups; 2) maintaining surveillance of malaria treatment practices by monitoring the clinical and parasitological response to therapy and the patterns of severe illness and death; 3) conducting surveys of KAP relating to malaria to measure the impact of the program; 4) providing training and health education and 5) facilitating essential operational research. This is consistent with A.I.D. and WHO policies for control of malaria in Africa.

It is recommended that A.I.D. support the development and implementation of the program in coordination with the MOH. A few of the activities can be integrated into its current support for PHC, such as the control of diarrheal diseases.

A.I.D. should provide the essential support for an effective program to control the leading cause of mortality among children younger than five in Ghana.

1. Introduction

1.1. Scope of project

The A.I.D. Policy Paper "Health Assistance" (1986)[4] states that in order to achieve A.I.D. child survival objectives, priority will be placed on four interventions that form the basis of the Agency Child Survival Strategy: immunization, diarrheal disease control emphasizing Oral Rehydration Therapy (ORT), nutrition and birth spacing. Malaria treatment and control also are essential to achieving child survival goals in many countries. In countries or regions where such interventions contribute significantly to reduction of infant and child mortality, they may be supported. In addition to continued emphasis on maximum feasible utilization of the Primary Health Care (PHC) system, current policy emphasizes the importance of the secondary and tertiary levels of the health care system. Finally, whereas most PHC projects have been concentrated in rural areas, current policy also encourages direct attention to urban health problems.

USAID\Accra's population and health program has taken a dual track of service delivery for its population program and oral rehydration therapy (ORT) program: improving the MOH service delivery system and developing a social marketing system for service delivery and product distribution through the private sector. Emphasis is placed on utilization and development of private and public sector delivery systems for PHC services. Important components of this approach include acceptability, sustainability, training of health delivery personnel such as intermediate level PHC personnel, traditional births attendants (TBAs), pharmacists and chemical sellers, and development of effective health education programs (A.I.D.88). This approach also lends itself to improving the delivery and effective use of appropriate treatment for malaria.

Malaria is a major cause of morbidity and mortality for children under 5 years of age in Ghana. Available data indicate that malaria is the most common cause of outpatient visits in Ghana. Malaria causes an estimated 10 to 15 percent of all deaths in children and accounts for more days of healthy life lost than any other disease in Ghana.[25] The malaria problem is further complicated by the development of chloroquine-resistant P. falciparum (CRPF). Chloroquine is still clinically effective and remains the drug of choice for treatment. However, the recent emergence of parasitologic resistance to chloroquine indicates that alternative drugs need to be evaluated in order to develop an effective treatment policy for malaria.

Numerous WHO meetings and documents have stressed the need for prompt diagnosis and treatment of malaria, selective use of vector control measures, creation of a specialized malaria unit at the central level, and involvement of

the general health services and community health workers in anti-malaria activities. African nations and their international collaborators now realize that the intolerable burden of severe illness and death due to malaria in Africa can be reduced substantially by the judicious use of drugs, even in the most remote areas and where CRPF parasites are transmitted.[9] Their main strategies are 1) to ensure prompt and effective treatment of high-risk groups with malaria (e.g. children younger than five and pregnant women; 2) to maintain surveillance of malaria treatment practices by monitoring the clinical and parasitological response to therapy and the patterns of severe malaria and death and 3) to develop national malaria control programs with detailed guidelines for implementation and control.

1.2. Ghana malaria control policies

A national policy on malaria control is currently being developed under the leadership of the MOH. This initiative was preceded by a national seminar, held on March 15 and 16, 1989, to review and analyze the malaria problem in Ghana. The anti-malaria strategy should concentrate initially on providing the sick with treatment, particularly those who are in danger of dying because of the deficiencies in the health delivery system and because there is no organized anti-malaria service. The strategies should include 1) provision of prompt and effective treatment of malaria cases at high risk; 2) determination of the efficacy of antimalarial drugs; 3) training and health education for malaria control; 4) effective malaria surveillance and 5) conduct of relevant, high-priority operational research.

A more complex or ambitious plan of malaria control should not be undertaken until it has been demonstrated that efficient malaria control activities have resulted in a reduction of mortality.

2. Malaria Assessment

2.1. Method of assessment

During the period April 10-30, 1989, a team consisting of Hans O. Lobel, M.D., M.P.H., a malaria epidemiologist from the Centers for Disease Control (CDC), and John C. Beier, Sc.D., a medical entomologist from The Johns Hopkins University, conducted a review of current and projected malaria control activities. The purpose of the consultancy was to develop an assessment of malaria and malaria control in Ghana and a plan of action in preparation for the malaria section of the A.I.D. Family and Child Survival Project Identification Document (PID).

The team held meetings with USAID officials and representatives of the MOH. Contacts were also made with other government representatives, missionary health delivery groups, researchers and representatives from the private sector involved in health care delivery, training and health education. A complete list of persons consulted can be found in Annex A. The team reviewed available geographic and demographic data, health delivery sector resources and utilization patterns, the epidemiology of malaria, current malaria control practices and knowledge, attitudes and practices relative to malaria. Based on this review, a Plan of Action was developed for consideration by A.I.D.

2.2. Geographic and demographic data

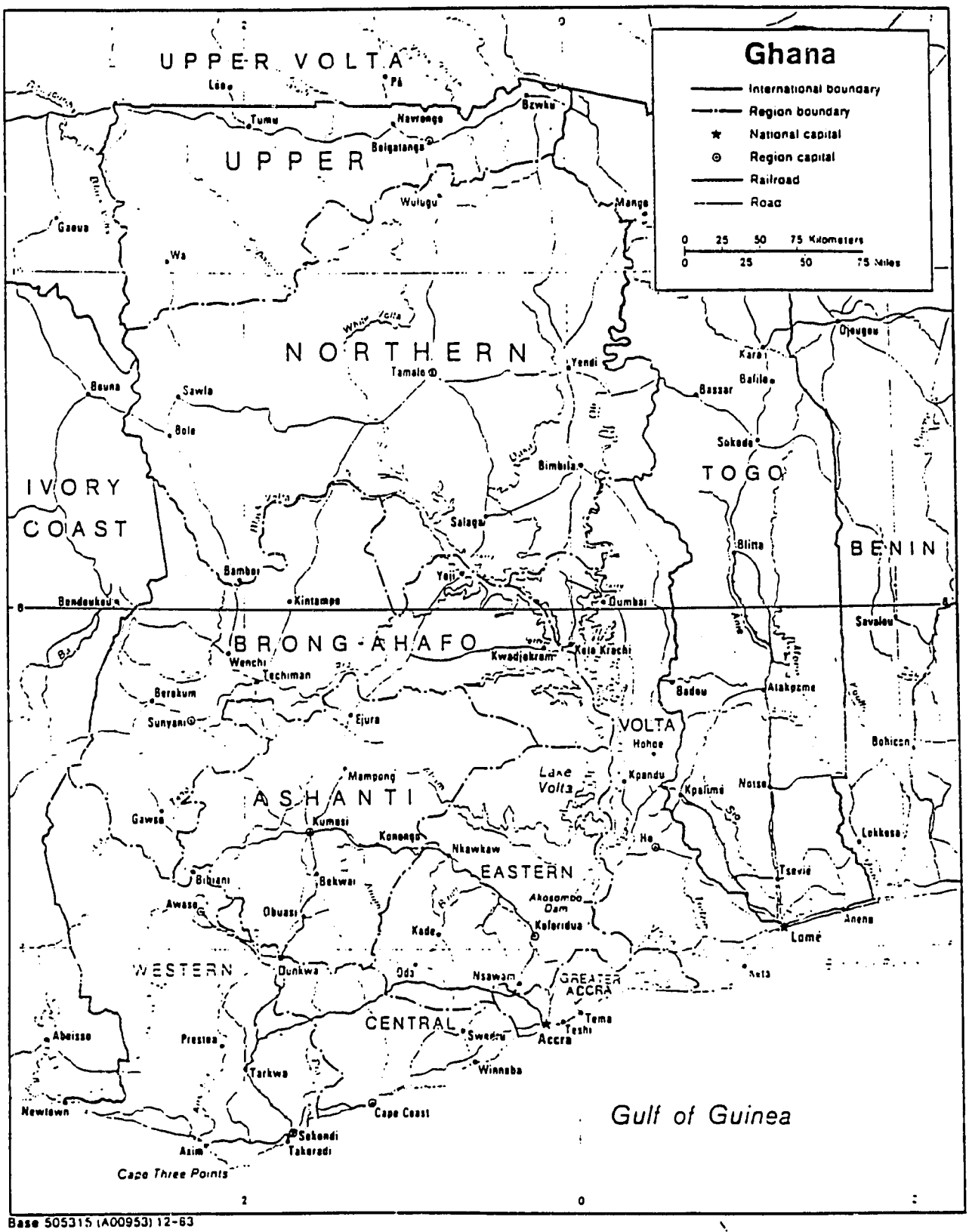
2.2.1. Geographic data

Ghana is located on West Africa's Gulf of Guinea only a few degrees north of the equator. It is bordered by the Atlantic Ocean to the south, Togo to the west, Ivory Coast to the east and Burkina Faso to the north. Ghana has an area of 92,100 square miles (238,538 sq. km) and a coastline of 334 miles (537 km). The three topographical regions, from south to north, are coastal plains and scrubland, rain forest, and savanna. The climate is tropical. Except in the north where the rainy seasons tend to merge, two rainy seasons are separated by a short, fairly dry period in July and August and a longer dry season from December to February. A dry, northeasterly wind blows in January and February. Annual rainfall ranges from less than 75 cm in the coastal area to over 200 cm in the tropical rain forest zone.

Many rivers flow from north to south in Ghana, creating problems for transportation and communication. The constructed Volta Lake extends from the Akosombo Dam in southeastern Ghana to the town of Yapei, 325 miles (520 km) to the north. The capital, Accra (pop. 953,500), is

located at the coast. The other principal towns are Kumasi, Cape Coast and Takoradi. A map of Ghana is shown on the following page.

Ghana has 10 regions and 110 districts. Each district has a District Council. Villages are governed by Village Development Committees (VDCs) and Committees for the Defense of the Revolution (CDRs). Assemblymen are elected by the village for representation in the district assembly. In addition to the administrative governmental system, traditional or tribal relations play an important role.



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2.2.2. Demographic data

The population of Ghana is 14 million (July 1988), 2.5 million (19 percent) of which are under 5 years of age. Seventy to 80 percent of the population is rural (living in localities of less than 5,000 population), ranging from 16 percent in Greater Accra region to 91 percent in Upper East region. There are 44,000 villages with a population of less than 500, and 3,000 with a population between 500 and 1,000. In 36,000 localities, there are less than 100 persons (Annex F, Table 1).

The 1988 age distribution of the population is estimated as follows:[31]

Age group	Population (000)	% of total population
0-11 months	473	3.4
1-4 years	2,110	15.6
5-14 years	3,706	27.4
15-45 years	5,451	40.3
45 and older	1,786	13.2
Total	13,526	100.0

The following estimates have been derived from references 2 and 31:

Average Annual Growth Rate	3%
Literacy Rate	30%
Rural population (1984)	70%
Urban population	30%
Working age population (15-64 years)	51%
Per capita GNP	US$ 200
Population /physician (1981)	14,768
Population with access to potable water (1981)	35%
Total fertility rate (1985)	6.5
Contraceptive prevalence (1988)	16%

Health statistics are derived from registration data, notifications and special surveys. It is estimated that only 40 percent of births and 25 percent of deaths are registered. The absence of good demographic data makes it difficult to measure the impact of health programs.[31]

Vital statistics:

Crude birth rate/1,000 (1985)	47
Crude death rate/1,000 (1985)	15
Infant Mortality Rate (1985)	96/1,000 live births
Under-five Mortality Rate/1,000	25
Life expectancy at birth	52 years

2.3. Health sector resources

2.3.1. GOG health resources

There are a number of agencies that handle health care in Ghana, but the government, through the Ministry of Health (MOH), is the largest provider of health services. These services are organized at three levels: national, regional and district.[31]

The MOH is responsible for all public health services. The Director of Medical Services (DMS) is responsible for the functional aspects of health operations in the country. The Deputy Director Medical Services (DDMS) (Hospitals) oversees the curative sector, and the DDMS (Public Health) the preventive sector. The Epidemiology Division is part of the DDMS (Public Health) and includes a unit for parasitic diseases, which was developed recently from the schistosomiasis unit. There is no central unit at the MOH responsible for development of a malaria control policy and for providing technical guidance for malaria control activities. It is expected that such a unit will be established with the development of a national malaria control policy.

Health statistics are maintained in the Epidemiology Division. The Division of Health Education is charged with developing and implementing health education and participates in the educational activities of the social marketing system for ORT. The Division of Maternal and Child Health (MCH) participates in the development of training modules for TBAs. The Division of Health Manpower and Training is concerned with development of training programs for health care delivery personnel.

The MOH is represented at the regional level by the Regional Director of Medical Health Services, whose responsibilities include the PHC. Each of the 10 regions has a Medical Field Unit, with District Health Management Teams (DHMTs) responsible for prevention and treatment, but not surveillance. Each region has a regional hospital. Korle Bu Regional Hospital in Accra and Komfo Anokye in Kumasi are the nation's teaching hospitals.

The district is the basic unit of health management and planning. About 48 of the 67 districts have hospitals and there are about 230 MOH health

posts and centers throughout the country. In addition, PHC units staffed by VHWs and birth attendants are located in some areas.

The general framework of the PHC system is a three-tier system, based on the district level.[25]

At level A, the community level, there are community health workers (CHWs) selected and compensated by the community itself, but trained by the MOH in primary prevention and promotion of first-level curative procedures, with emphasis on pregnancy management, child health promotion, environmental sanitation and mobilization for health-related community projects. There are at least two types of level A workers: the traditional birth attendant (TBA), who is generally illiterate, and the community health worker (CHW), who usually has a primary school education. A third function, organizing community development, may involve a village development worker (VDW) or may be the responsibility of the village development committee.

At the second level, level B, there are the health center/health post/health stations. These facilities are staffed with MOH community health nurse/midwives (CHN/MW), who have additional minimal training in therapeutic procedures, and community environmental development officers, who are assistant health sanitarians. These persons have completed two years of MOH training. Their principal responsibilities include technical supervision of VHWs, routine immunizations and care for patients referred from level A.

Level C is at the district level (population 150,000-200,000) and comprises the DHMT. A DHMT consists of a district medical officer (DMO) who has special postgraduate training, a district public health nurse (DPHN), a district health administrator and a district health inspector. They are involved in training, managing, planning and evaluating district PHC programs.

Maternal and child health (MCH) services in the PHC system include immunization, growth monitoring (weighing), maternal care and family planning, nutrition and health education, school health services, home visiting and preschool feeding programs, as well as treatment of common medical problems such as malaria, diarrhea, acute respiratory infections, skin infections and burns. MCH services are provided by hospitals, health centers and health posts operated by the MOH and religious missions.

The six priority areas of the PHC include diarrheal disease control, immunization against vaccine preventable diseases, malnutrition, maternal and perinatal mortality, and family planning.[3] Training is provided in the six priority areas. Efforts are made to improve the intersectorial coordination, optimization of resources, and community involvement and participation.

Major difficulties in implementing the PHC program include the inability to attract medical officers into district work, a lack of transportation and supplies, insufficient staff and non-functioning equipment.

Cost recovery in the form of fees for hospital, health centers, health posts and drugs was initiated in 1985.

Implementation of the referral system has been ineffective because of poor communications, poor organization and delivery of PHC at the periphery, and improper referrals. It has been suggested that level B facilities should be made mobile.[3]

2.3.2. Other providers of health care

Other providers of health services are private voluntary agencies, private practitioners, quasi-governmental organizations and the uniformed forces health services. The largest private voluntary agency involved in health care is the Church Hospitals Association of Ghana (CHAG). CHAG comprises health care units operated by the Catholic, Presbyterian, Methodist and other churches. It is involved in the development of the PHC program and also operates training programs for nurses and midwives. Mission hospitals are particularly important in Brong-Ahafo, Volta and the Upper regions.

Quasi-governmental organizations such as the Volta River Authority, Volta Aluminum and universities operate hospitals and clinics for their workers or students and their immediate families.

Sixty to 70 percent of Ghanaians, particularly in rural areas, rely on traditional medical practitioners or use traditional medicines at home. There are some 100,000 traditional healers, including herbalists, TBAs, bone healers, specialists in women's health problems (especially infertility), psychic healers, spiritualists and modern traditional healers. Much of traditional medicine is based on the effect of the supernatural on health. The MOH research center at Mampong-Akwapim in Eastern Region is devoted to the study of traditional healing remedies, particularly plant medicine.

2.3.3. Health care coverage

A 1984 PHC review in a sample of 12 districts estimated a 50 to 60 percent coverage as reflected by outpatient visits.[34] A 1988 study estimates the coverage closer to 20 percent of the population. Another estimate suggests that 30 percent of the population has access to any formal medical care, i.e. lives within 5-8 km. of a private or public health institution. A 1986 WHO report to MOH indicated that there were 699 village community clinics, 1,813 village health workers and 2,353 trained TBAs. The 1984 census data indicate that there are more than 50,000 communities (comprising 71

percent of the population) with a population of less than 5,000. According to a 1988 PHC Review, 42 percent of sick children younger than five in rural areas used health facilities (private and public), compared to 56 percent of children in urban areas. Annex F, table 2 indicates the proportion of households using the various types of facilities for their sick children. All estimates indicate inadequate coverage of the rural populations by current approaches, suggesting a need for additional methods to supplement the MOH delivery of health services.

2.3.4. Health facilities

Ghana has a total of 147 hospitals (of which 35 are operated by CHAG), 252 MOH health posts and centers, and 174 clinics. MOH health facilities tend to be located in areas with higher population densities, whereas the CHAG organizations are oriented towards health delivery in remote rural areas. Mission facilities have fewer administrative personnel in comparison to MOH institutions.[31]

Health facilities by type and controlling agency are listed below:

	Government	Non-MOH	Mission	Total
Hospitals	57	55	35	147
Health Centers/posts	252			252
Clinics	139		35	174

2.3.5. Health personnel

Two-thirds of Ghana's 948 physicians work in MOH facilities, 27 percent work in private clinics and hospitals (concentrated in urban areas), and 8 percent in mission health institutions. Although few in number, mission physicians are a major source of medical care in rural Ghana. Forty-seven percent of all physicians work in the two teaching hospitals, and only 28 percent of all physicians work in rural areas. Few nurses work in PHC.

The number of health workers in Ghana is estimated to be as follows:[31]

Doctors	948
Clinical nursing personnel	10,067
PHNs	268
CHNs	1,527
Private registered midwives	250
Pharmacists	487
Chemical sellers	3,077
Dispensary tech/asst	497
X-ray technicians	146
Dispensing Tech/Asst	497
Lab. Technicians	242
X-Ray technicians	146
PHC technicians	1,866
Env. sanitation engineers	1,202
VHWs	1,813
Trained TBAs	2,353

2.3.6. Pharmaceuticals

A list of essential drugs has been developed and a national drug policy is being formulated by the Ghana national drug committee. There is limited government supervision over quality control. Most drugs, including anti-malarials, are available without prescription.

Drugs are distributed through the MOH, missionary and private health facilities and hospitals, pharmaceutical firms, pharmacies, chemical sellers, shops and some traditional healers. There is no reliable information about quality and quantity of existing pharmaceutical stocks within the public health care system.[31]

2.3.7. International donor support

International donor support for PHC has been received from the World Bank, several United Nations agencies and a number of bilateral and multilateral agencies. No support for specific malaria control could be identified.

2.4. Health information system

Because of the rural population's limited access to the health delivery system, many births and deaths are not registered and illnesses of much of the population are not brought to the attention of the curative services.[31] MOH hospitals and health centers tend to be located in larger communities, so routine MOH statistics do not adequately reflect trends in rural areas. Special studies and surveys provide more detailed and accurate data than the routine statistics. A

1984 UNICEF situation analysis provides data on the socio-economic, health, education and environmental situation in Ghana.[34] A population survey indicated that fever was the most common health condition. It had been experienced during the preceding two weeks by 26 percent of rural and 23 percent of urban respondents. Fever was followed by diarrhea, which was reported over the same time period by 16 percent and 14 percent, respectively.[3]

The National Catholic Secretariat in Accra receives annual reports from the Catholic mission hospitals, all of which are located in rural areas underserved by the MOH curative services. These reports include statistics on numbers and diagnoses for outpatient visits and hospital admissions, and causes of death, usually grouped by age.

2.5. Malaria

2.5.1. Epidemiology

The main aim of the epidemiological approach to malaria control is to develop a better understanding of the dynamics of malaria transmission and the risk of infection, illness and death, and to identify the methodologies for malaria control as part of the development of PHC. No reliable information is available on morbidity and mortality due to malaria in Ghana. Such information is needed to assess the impact of malaria control measures.

Only limited information is available on the epidemiology of malaria in Ghana. Transmission of malaria is considered to be highest during the rainy seasons. Geographic variations may exist.

Almost all malaria infections in Ghana are due to Plasmodium falciparum, which can result in high fever, convulsions, severe anemia and occasionally to cerebral malaria (the most severe form of this disease). In Ghana, each infant who becomes infected during the first year of life has a high risk of mortality in infancy and early childhood. During that period, each child has an estimated four to nine febrile episodes per year. After immunity develops, the risk of dying is reduced but it is assumed that everyone has recurrent attacks of malaria averaging two attacks of one week each year.

The risk of dying of malaria is high. In Accra between 1948-1952, 14 percent of all deaths in infancy and one-third of all deaths between ages one and five were attributed to malaria.[17] Bruce-Chwatt estimated that in 1952, 12.5 per 1000 infants and 7 per 1,000 children under five years of age died from malaria each year in Lagos.[10] Recently, the malaria mortality rate in rural Gambia was reported to be 6.3 per 1000 per year in infants under 1 year, and 10.7 per 1000 per year in children aged 1-4 years.[21] Molineaux estimated the case fatality rate (CFR) due to malaria to be 15 to 20 percent among African children with AA hemoglobin.[21] The CFR at the Ghana Medical School at Korle Bu is reported to be six percent (Neequaye J. Per-

sonal communication, 1989). The same CFR was observed in 1987 at a mission hospital in Ghana.

The uncontrolled occurrence of malaria places a heavy demand on the health services system. MOH statistics indicate that malaria is the most frequent reason for outpatient visits. (Annex F, table 3). This disease accounted for 43 percent of all visits, compared to only 8 percent for diarrhea, the second leading reason for outpatient visits. In four mission hospitals, malaria in 1978 accounted for 23,550 of 74,000 (32 percent) OPD visits, and for 59% of all admissions of children younger than five.

Malaria is the leading cause of loss of healthy life in Ghana at all ages; 51 percent of this loss is due to mortality and 49 percent to morbidity.[26] This suggests that prompt, effective treatment of malaria is important not only to reduce the mortality at an early age, but also to reduce the length of illness at all ages.

Ghana's disease problems ranked in order of healthy days lost

Rank order	Disease	Days of healthy life lost per 1000 persons per year	% of total
1	Malaria	32,600	10.2
2	Measles	23,400	7.3
3	Pneumonia (child)	18,600	5.8
4	Sickle cell disease	17,500	5.5
5	Malnutrition (severe)	17,500	5.5
6	Prematurity	16,800	5.2
7	Birth injury	16,400	5.2
8	Accidents	14,900	4.7
9	Gastroenteritis	14,500	4.5
10	Tuberculosis	11,000	3.5

Source: Ghana Health Assessment Project Team (1981)

A survey of parasitemia, antibodies and antimalarial practices in 1978 indicates that in Accra, 2.5 percent of children under 5 years old had a parasitemia, compared to 21 percent of such children in Berekuso, a village 56 km north of Accra.[20] In 1964-65, infection rates among children younger than five were 12 percent in Accra and 22 percent in the periphery. Parasite rates were 11 percent in Accra in infants and 44 percent in children 3-4 years

old in 1955. In the rural Danfa project area, parasite rates in the 0-11 year age group ranged from 30 percent in November 1973 to 18 percent in October 1974 and 12 percent in June 1975. This age group had a parasite rate of 22 percent in November 1978.

Quarterly surveys among children under 5 years of age in three rural villages in Central Region between December 1986 and September 1987 revealed parasite rates between 19.6 and 44.0 percent. All infections were due to P. falciparum (4.1 percent were mixed infections). Parasite rates were higher during the rainy season than in the dry season (Afari EA, personal communication, 1989).

In a community-based survey in the Western region, 68 percent of 1979 children younger than five had had an episode of febrile illness during the two weeks prior to the survey.[1]

2.5.2. Treatment and diagnosis

The development of specific diagnostic criteria and indications for treatment is important in order to preserve the efficacy of antimalarial drugs as well as to prevent progress to severe illness or death. Microscopic diagnosis of malaria is impractical at the peripheral and intermediate levels of the PHC system. The clinical status is the deciding factor in determining whether the child needs treatment and whether referral to a clinic or hospital is needed. The best clinical indicators for diagnosing malaria and following the clinical response are a history of recent fever and an elevated temperature. All children with fever need to be treated with an effective drug and a precise dosage regimen needs to be followed.

Chloroquine remains the drug of choice for treatment of malaria. The emergence of CRPF is an important development in Ghana, but studies in several African countries have shown that in areas with a high prevalence of resistance, mostly of the intermediate type (RII), treatment with 25 mg/kg resulted in total parasite clearance in 43 to 78 percent of patients. Of critical importance is that children treated with chloroquine had, on the average, a 98 percent reduction in their initial parasite density and more than 90 percent of those with fever improved clinically.[9]

There is no national policy regarding use of antimalarial drugs. The 1988 list of essential drugs includes chloroquine (oral and s.c.), amodiaquine, and quinine (oral and i.v) for treatment of malaria. Pyrimethamine/ sulfadoxine (Fansidar) is not listed as an antimalarial, but it is given by health providers and used for self-medication for malaria. Mefloquine is also used for treatment. Chloroquine is imported as the raw product from several countries and formulated and marketed by some 15 to 20 producers. Quality control is left up to the manufacturer.

There is no standardization of treatment regimens, nor of the marketed products. There are no written treatment schedules at the MOH facilities for use by health care providers. The dosages for children are estimated on the basis of stated age, if at all. Printed dosages on some chloroquine syrup bottles are very confusing. Chloroquine syrup is marketed in concentrations of 25mg, 50mg, 75mg and 80 mg per 5ml. It is common to give an injection of chloroquine for treatment to all patients with "malaria," followed by oral chloroquine.

Self-medication is common.[20] First-line treatment, prescribed by traditional healers or relatives, often consists of herbal medicines. Undermedication with chloroquine is perceived as a major problem that may influence the development of drug resistance.

2.5.3. Drug response of P. falciparum

The presence of chloroquine resistance in Ghana means that a policy is needed for the rational use of drugs. The development of a surveillance system to identify treatment failures and the establishment of criteria for switching to alternative drugs and doses are key elements in an adequate malaria control program.

Finding resistance to antimalarial drugs is not a new phenomenon. In 1961, resistance to chlorproguanil developed following weekly use of 20 mg proguanil.[11] Evidence was found for cross-resistance between pyrimethamine and chlorproguanil. Resistance to pyrimethamine also developed following self-medication. In vivo studies in 1967 failed to demonstrate resistance to chloroquine in Obuasi, Ashanti region and in Axim.[7,8] In vitro studies of material from 27 patients did not demonstrate resistance to chloroquine. In 1986, a case of treatment failure with 45mg/kg chloroquine base in a Ghanaian child with sickle cell disease (SS) was reported.[28] In 1988, RI resistance was reported in one child and RII resistance in two children at Korle Bu Teaching Hospital.[27] Similarly, resistance in three of 77 children was reported in 1988, but they had had large amounts of chloroquine prior to testing.[30] Treatment failure with three tablets of Fansidar, and subsequently with 2700 mg CQ was reported in an Italian traveler in 1988 (Piro S, unpublished observation, 1988).

Between June and October 1988, an in vivo study to determine the sensitivity of P. falciparum to 25 mg/kg of chloroquine was conducted in 144 children 6 to 15 years of age in three communities (urban, peri-urban, and rural) in the Greater Accra Region. Blood slides were taken on days 0, 2, 4, and 7. Of the 144, 116 (80.6 percent) were sensitive, 28 (19.4 percent) showed resistance to chloroquine at RI, and 23 (15.9 percent) at RII. Of 92 successful in vitro micro tests, 54 were resistant to CQ (Afari et al, 1989. personal communication).

2.5.4. Entomology

Primary mosquito vectors of malaria in Ghana, as in all of west Africa, include the Anopheles gambiae complex and An. funestus. The An. gambiae complex in Ghana includes An. gambiae sensu strictu throughout most of the country and An. melas, a salt-water species, in the coastal areas. Anopheles arabiensis has not been reported. Members of the An. gambiae complex have not been differentiated by polytene chromosome techniques in Ghana; thus, the taxonomic identity of the most important vectors remains to be confirmed. Anopheles nili is considered a secondary vector.

Surveys in Accra have demonstrated the importance of An. gambiae as an urban malaria vector (Chinery 1968, 1969, 1970). Chinery (1984) documented the adaptation of An. gambiae to breed in water-filled domestic containers in Accra, an important factor in the maintenance of urban malaria transmission. In the southeast part of the Volta Region, Bakri (WHO unpubl. document, AFR/MAL/86) in 1965 and 1966 conducted detailed entomological studies as part of the WHO malaria pre-eradication program in Ghana. High rates of malaria prevalence were associated with high densities of An. gambiae and An. funestus resting in houses and feeding predominately on humans. Vector infection rates ranged from 0 to 21 percent. The WHO studies showed that transmission in the Volta Region was year-round, with seasonal peaks associated with the rainy seasons from April to June and September and October.

Ecological studies to characterize the intensity of malaria transmission patterns by Anopheles vectors have been conducted only in limited areas of Ghana (e.g. Accra and the Volta Region). There is limited current information on vector distribution, abundance, host-feeding patterns, longevity, sporozoite rates and inoculation rates. At this time, it is impossible to estimate entomologically the risk and intensity of malaria transmission anywhere in Ghana.

2.5.5. Past and current control activities

Before World War II, schoolchildren were given quinine two times per week. This drug was also sold through all post offices. A chloroquinized salt project was tried between 1959 and 1963. Currently, less than half of children with malaria receive antimalarial drugs for treatment.[19]

Vector control activities in Ghana have traditionally emphasized larval and adult mosquito control through the MOH. Mosquito control activities in the first half of the century focused on drain construction and maintenance, elimination of mosquito larval development in domestic containers, larviciding with kerosene, source reduction, use of DDT as a larvicide and occasionally as a residual adulticide after World War II (Chinery 1984). From 1964 to

1966, extensive control activities involved treating permanent bodies of water with diesel oil, DDT, dieldrin or gamexane (Chinery 1969).

Prior to 1957, vector control activities were the responsibility of Regional MOH units (R. Sackey, pers. commun.). In 1959, a national malaria unit was started in Ho in the Volta Region as part of the WHO global malaria pre-eradication program, which was suspended in 1967. Other attempts to control mosquitoes since 1967, including a 1982 national mosquito program based on aerial spraying and larviciding, have met with little success. These approaches were popular but could not be sustained.

Currently, there are no organized vector control operations in Ghana. Sanitation and mosquito control is a local government and community responsibility. There are 1,544 MOH technical officers, ranging from the Chief Health Inspector to Health Inspection Assistants, trained in mosquito control, but vector control is not an MOH priority. Personal protective measures, including screening of houses and the use of bed nets, pyrethrum mosquito coils and spray cans, are practiced in some urban and rural areas of Ghana. Secondary school children throughout the country are required to use mosquito nets in the boarding rooms. However, personal protective measures are not widely practiced because only 12 to 49 percent of the people are aware that mosquitoes are associated with malaria (Section 2.5.6.).

2.5.6. Knowledge, attitude and practices

A survey in 1978 in Accra and rural Berekuso indicated that most people treated themselves for febrile episodes (87 percent in Accra, 94 percent in the village). The most commonly used drug was chloroquine. Urban residents were more likely than villagers to use antipyretics. Antimalarial drugs were used regularly for prophylaxis by 37 percent of the respondents in Accra and only three percent of the rural residents. Personal anti-mosquito measures were not used in the rural village, none of the houses had mosquito proofing, and no one used bed nets, mosquito coils or insecticide sprays. In Accra, few houses were proofed against mosquitoes, but 49 percent of the respondents used either mosquito coils or sprays daily, 32 percent used them occasionally, and nine percent used mosquito nets.[20]

In 1985, UNICEF supported a community-based survey covering 16 districts and 1,000 households per district, using standard questionnaires.[19] Information was obtained about community facilities, availability of health services, population distribution, literacy, community-felt needs, and about knowledge, attitude, and practices (KAP) of PHC interventions (ORT, nutrition, MCH, sanitation and EPI). KAP questions about causes, treatment and prevention of malaria were also included (Annex F, tables 4-6). The results showed that mosquitoes are not often associated with malaria, that chloroquine is used for treatment by, at most, less than half of the cases, and

that cleanliness and avoiding sunshine were often suggested means to avoid malaria. Clearly, a large, effective health education program is needed.

2.5.7. Operational research

Limited operational research on malaria has been conducted in Ghana during the past decade. Examples include:

1. A survey of malaria parasitemia, antibodies and antimalarial practices in one urban and one rural area of southern Ghana;[20]

2. Extensive population-based MOH surveys using standardized methodology to assess "knowledge, attitudes and practices" relating to malaria transmission, treatment and prevention;[19]

3. Longitudinal epidemiological studies being conducted by the Noguchi Memorial Institute for Medical Research on malaria and other infectious diseases in three villages in the Coastal Region. These studies measure malaria incidence in children younger than five and monitor in vivo and in vitro response of P. falciparum to chloroquine and other antimalarial drugs; and

4. Vector studies conducted by the MOH in the Greater Accra Region focus on Anopheles distribution, relative abundance and behavior in relation to malaria prevalence.

3. Objectives and strategies

3.1. Objectives of malaria control

To reduce the mortality due to malaria among children younger than five years of age through prompt, effective treatment.

To reduce the duration of illness due to malaria among children younger than five through prompt, effective treatment.

3.2. Strategies to meet the objectives

The following strategies are recommended:

1. Providing prompt, effective treatment of malaria cases at high risk.
2. Determining the efficacy of recommended treatment regimens.
3. Providing training and health education.
4. Conducting surveillance of malaria morbidity and mortality
5. Conducting essential operational research

Key issues for an effective program include therapy, delivery of services, health education, training and measurement of impact.

4. Plan of Action

4.1. Prompt and effective treatment of malaria

Prompt treatment of malaria is important in order to prevent progression to severe illness or death and to reduce the duration of the illness. Adequate dosaging with chloroquine is essential to limit suboptimal use, which may promote development of resistance. Mild and uncomplicated cases of malaria can be treated at levels A and B.

4.1.1. Definition of malaria cases

a. A mild case is to be defined as a patient with fever who is able to take oral medications.

b. Severe malaria is defined as a patient with potentially fatal manifestations or complications of malaria, such as:

- o persistent vomiting
- o neurological signs: confusion, obtundation, unconsciousness, convulsions
- o hyperparasitism (>5% parasitemia)
- o severe anemia (hematocrit <20%)
- o hypothermia -- rectal temperature <35 C
- o jaundice
- o hypoglycemia (blood glucose <2.2 mmol/l or <40 mg/dl)
- o dehydration
- o pneumonia (must be treated in a medical center)

4.1.2. Diagnosis and referral for malaria

No microscopic diagnosis is possible at level A or, usually, at level B. All children under 5 years of age with fever or a history of fever need to be treated for malaria within 48 hours. If they have signs or symptoms of other causes of fever, they also need treatment for those causes. Annex B presents a simple fever management protocol for all ages. Severe cases of malaria and patients who fail to respond to therapy in 72 hours at the periphery or intermediate level need to be referred to a hospital. Annex C presents a schematic referral diagram.

At the intermediate B level, laboratory capability for microscopic examinations of blood smears may be available. Patients visiting the B level health center for the first time should be handled as outlined for the periphery. Patients referred from the periphery need to be examined by a medical officer.

4.1.3. Standardization of therapy

Therapeutic criteria need to be standardized to ensure use of economic and effective therapy. These criteria need to be documented, provided to all health service providers and displayed in all health facilities. Use of ineffective and unnecessarily expensive drugs needs to be avoided. Utilization of the therapeutic guidelines should be monitored. Annex D provides an algorithm for the treatment of malaria used in several African countries. See Annex E for standardization of malaria treatment.

4.1.4. Access to effective therapy

It is essential that there be an adequate supply of recommended drugs readily available at the periphery, the intermediate levels and all hospitals.

An effective social marketing system might be useful to supplement the MOH health delivery system to ensure that chloroquine is available at the village level. A prepackaging method that promotes compliance with recommended dosaging for different age groups would help significantly in the dispensing and utilization of adequate amounts of therapy. Such a marketing system needs to develop methods that limit unnecessary use of antimalarial drugs. The Ghana Social Marketing Program (GSMP), which also distributes and markets ORS, could be a channel to promote adequate use of chloroquine.

4.1.5. Laboratory diagnosis of malaria

All hospitals need to have an adequate laboratory capability to diagnose malaria.

Thick blood smears stained with field stain or Giemsa are necessary at the hospital level to confirm the diagnosis of malaria. Any thick smear containing malaria trophozoites is diagnostic for malaria. Thick smears should be examined, if possible:

- for monitoring patients who have been treated presumptively and still have signs and symptoms three days (72 hours) after beginning treatment;
- for monitoring patients with fever and cerebral signs such as lethargy or convulsion or other signs/symptoms requiring hospitalization; and
- during <u>in vivo</u> drug testing.

4.2. Monitoring of antimalarial drug efficacy

Monitoring the efficacy of recommended regimens is necessary to ensure that P. falciparum infections are sensitive to the recommended drug regimens and to permit changing these recommendations when necessary. The surveillance can be implemented through:

4.2.1. Surveillance of therapy failures

A. Criteria for suspecting resistance of P. falciparum

1. Persistence of fever 72 hours after treatment has been confirmed by health personnel (taking of medicine at health center or assurance that the drug has been taken at home).

2. Elimination of other possible and obvious causes of fever.

B. Procedures:

1. Verify that the drug has been correctly administered.

2. Obtain information on vomiting and diarrhea during the period of treatment (which could explain malabsorption of the medicine).

3. If you cannot confirm that the medicine has been taken, give another chloroquine treatment with the required, recommended dose in the health center. See the patient again two days after the beginning of treatment. If there is no improvement, refer the patient to the hospital.

C. Evaluation at the hospital level:

1. Confirm above information. Complete clinical and laboratory follow-up until child is cured.

Possibilities:

1. Thick smear negative at arrival: need to look for other possible causes of fever. The case is not resistant P. falciparum.

2. Clinical and laboratory follow-up: thick smear is positive at arrival. Seek to confirm possible malabsorption through history of vomiting or diarrhea or through urine test, if possible.

    a) If the urine test is negative, the patient needs treatment with chloroquine and its administration and absorption should be monitored.

b) If the urine test is positive, give alternative antimalarial drug recommended. In this case, the P. falciparum is probably resistant.

c) Without a urine test, treat with the usual course of chloroquine. In this situation, the case is suspected to be resistant.

4.2.2. In vivo surveys for assessing drug response

If two to five probably chloroquine-resistant cases of P. falciparum are confirmed in a period of a year or less, officials at the central level need to be notified. Such officials need to be able to undertake in vivo assessments of parasitologic and clinical response to treatment. In vivo testing is essential for developing drug therapy strategies. In assessing the response to treatment, it is essential that patients have ingested and absorbed the drug and that the drug contains the correct quantity of active ingredient. Special testing may be necessary to ensure that the drug has been absorbed and that the drugs are potent before determining that drug-resistant strains of P. falciparum are present. The protocols for in vivo testing are found in *Chemotherapy of Malaria* by L.J. Bruce-Chwatt et al, second edition, revision 1, 1986, WHO, Geneva.

4.3. Training

A strong training component is essential to developing an effective malaria control program. Training of hospital personnel, peripheral health workers and laboratory workers should be part of the series of primary health care training sessions that are now targeted on the six priority areas of the PHC. Because of the severe shortage of professional personnel with training in malariology, long-term career development opportunities are needed for sustaining a national effort in malaria control.

Training should focus on the following:

1. Developing self- and group-learning manuals for the diagnosis and treatment of malaria, the management of patients, and methods to reduce man-vector contact, to be used in country-wide training sessions.

2. Conducting in-country professional and technical training courses in malaria patient management, the microscopic diagnosis of Plasmodium parasites, and the determination of drug resistance.

3. Providing graduate-level career development opportunities in the fields of epidemiology, medical entomology, parasitology and immunology to strengthen national manpower capabilities necessary for malaria control.

4.4. Health education

Parents and communities must be involved in the process of malaria recognition, therapy and prevention if existing patterns of childhood morbidity and mortality are to be improved. Health education and community mobilization are essential in order to increase public awareness of malaria, promote use of recommended drugs, discourage use of ineffective or expensive drugs and unnecessary injections, and to promote individual and community actions that reduce man-vector contact. The strategies for health education should be based on the communities' perception of the causes of malaria, usual treatment practices and personal protective measures to decrease their risk of infection.

Such activities need to include:

1. Developing and providing malaria control materials for use in schools, communities and health facilities.

2. Developing radio, television and newspaper information messages about treatment of fever, use of personal protective measures (bed nets, repellents, insecticides), and vector control.

3. Ensuring regular messages on radio, television and newspapers.

4. Providing similar messages to the CDRs.

5. Establishing a malaria newsletter to inform health practitioners and researchers at all levels of recommended antimalarial therapy and national developments in malaria control.

4.5. Surveillance of malaria

In order to monitor trends of malaria morbidity and mortality and to assess the impact of malaria control, it will be useful to supplement the routine surveillance of malaria with information on malaria cases and deaths seen at selected sentinel health facilities. Such facilities could include a sample of public, private and mission health facilities. The following indices among children under 5 years of age would be useful:

1. the number and proportion of fever cases at sentinel health posts, health centers and hospitals;

2. the proportion of cases presenting as severe malaria;

3. hospitalization rates for malaria; and

4. the case fatality rate due to malaria.

4.6. Operational research

Operational research is an essential component of planning and evaluation of malaria control strategies. By serving as the mechanism for understanding the epidemiology and the dynamics of malaria transmission, it provides essential information to guide malaria control policies. In Africa, drug therapy may decrease the risk of severe infection, but will not, by itself, alter levels of transmission. The intensity and prevalence of malaria in Ghana cannot be expected to change unless long-term solutions are developed from carefully planned operational research.

Priority areas for operational research include:

1. Surveys of KAP that influence control of malaria, including utilization of health services, malaria treatment practices, the impact of health education and the effectiveness of personal protective measures for malaria control.

2. Methods to improve the production, distribution, utilization and evaluation of personal protective measures (e.g. mosquito nets, insecticide-impregnated mosquito nets, coils, repellents and window screens).

3. Epidemiology of malaria transmission by Anopheles vectors in different ecological zones in Ghana to assess the risk of transmission in relation to patterns of mortality and morbidity.

5. Monitoring and Evaluation

5.1. Indicators

The activities of a malaria control program need to be monitored by health and process indicators. Suggested indicators to evaluate the activities include the following:

Health impact

1. Infant mortality rates
2. Mortality rate of children younger than five

Treatment of cases

1. Proportion of cases under five years of age treated with correct drug and dosage, by VHWs and at health facilities
2. Proportion of cases under five years of age completing the three-day therapy
3. Percent of cases under five years of age treated on first day of fever
4. Percent of cases under five years of age given non-recommended therapy
5. Number and percentage of health facilities using appropriate antimalarial drugs for more than three weeks per month
6. Number and percentage of districts using therapy prescribed by the program
7. Number and percentage of health facilities that have received notice of the standard method of treatment

Malaria surveillance

1. Proportion of probable malaria cases among children younger than five treated by VHWs and in health facilities
2. Number and proportion of malaria admissions to pediatric wards
3. Proportion of severe cases among pediatric admissions for malaria

4. Proportion of deaths due to malaria of all deaths among hospitalized children younger than five

5. Case fatality rates for malaria among hospitalized children under 5 years of age

Drug management

1. Quantities of approved antimalarial drugs available in villages and at health facilities

2. Percentage of days without approved antimalarial drugs

3. Quantities of aspirin available

Surveillance of treatment

1. Number of health facilities where response failures to standard treatment have been recorded

2. Number of patients for which response to standard treatment has been recorded

3. Number (percentage) of treatment failures in health facilities

4. Number of in vivo drug sensitivity investigations and results

Training

1. Number and percentage of medical schools and nursing schools that have included malaria control in their curricula

2. Number and percentage of VHWs and health personnel who have been trained in malaria control

3. Number of health facilities that have organized training seminars

4. Number of microscopists who have received training

Health education

1. Number of educational sessions organized through radio and television

2. Number of districts that have received and used the information

3. Percentage of mothers attending antenatal or under fives clinics who know that a child with fever should be treated with chloroquine

Annex A

Persons Consulted

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Mr. Ed Birgles, Deputy Director, USAID Mission/Ghana
Mr. A.E. Boateng, General Manager/Director, Danafco Ltd.
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Mr. Robert S. Sackey, Chief Health Inspector, MOH
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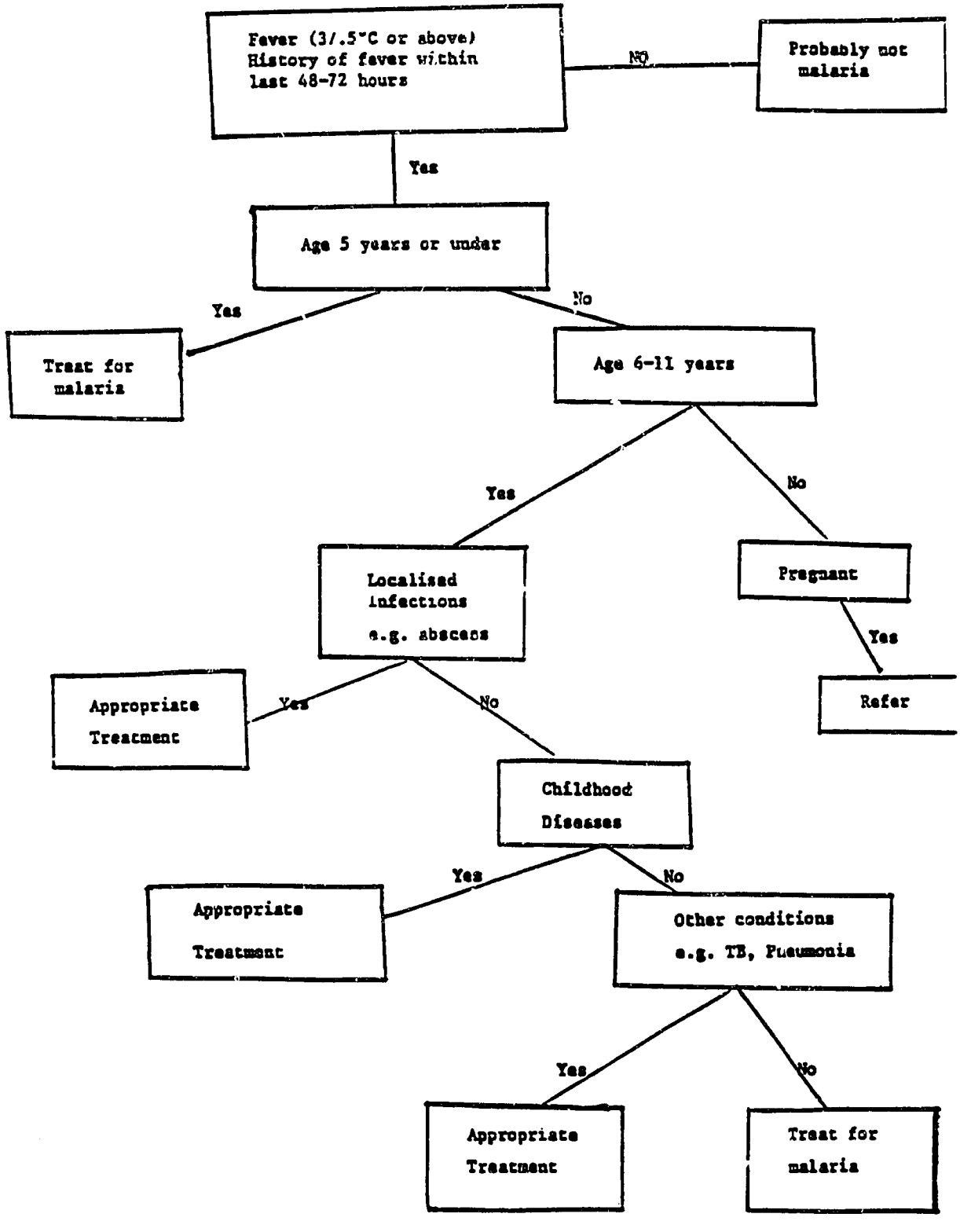
Mr. F. Gary Towery, Director, USAID Mission/Ghana
Lt. Col. E.A.K. Wayo, M.D., 37 Military Hospital
Ms. Diane William, PATH

Annex B

Example of a Simple Fever Protocol In an Area of Perennial Transmission and High Endemicity

EXAMPLE OF A SIMPLE FEVER PROTOCOL IN AN AREA OF PERENNIAL TRANSMISSION AND HIGH MALARIA ENDEMICITY

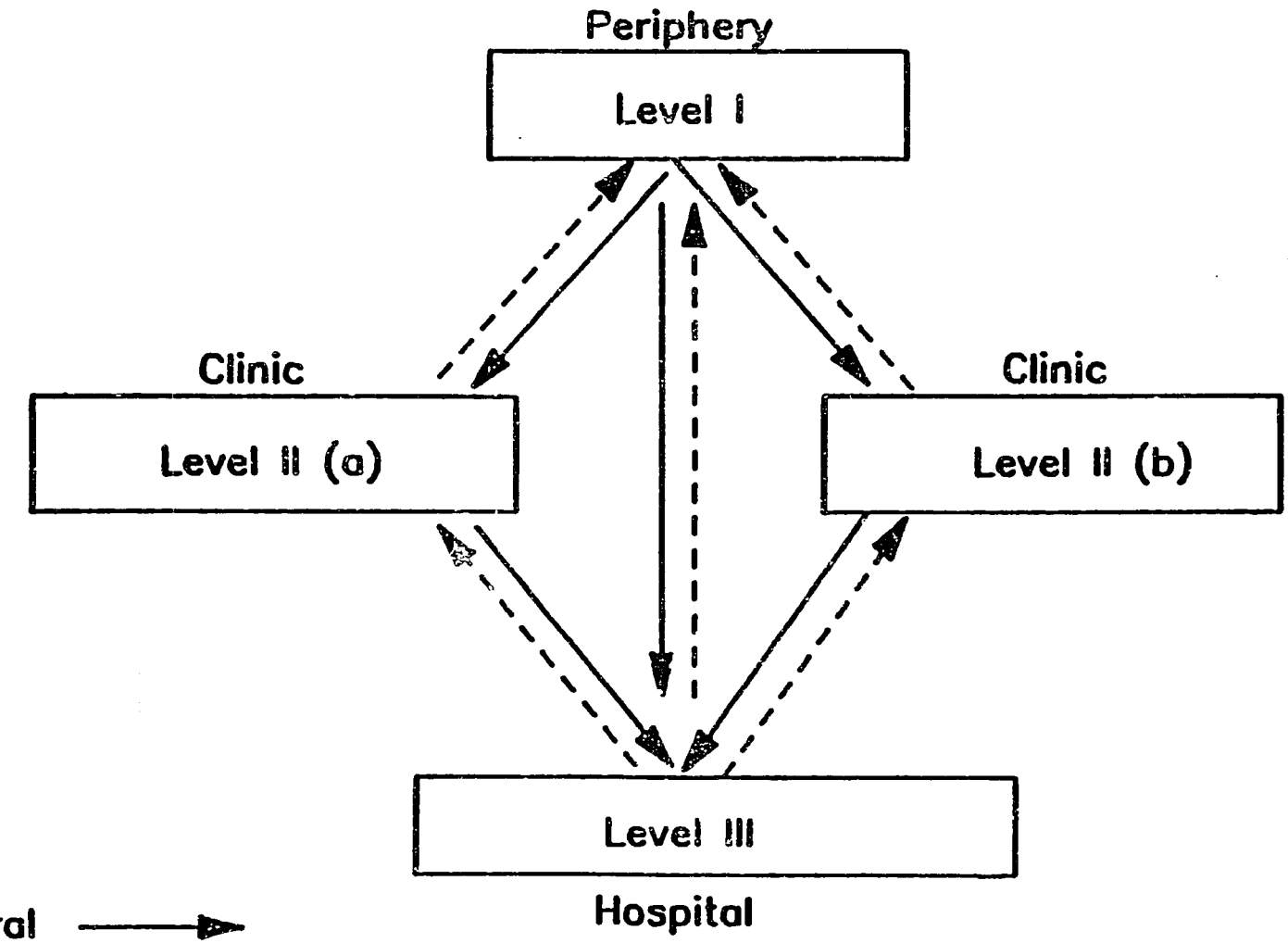


Annex C

Referral of Malaria Cases

by Level of Health Care Delivery

Referral of Malaria Cases by the Various Levels of Health Care Delivery

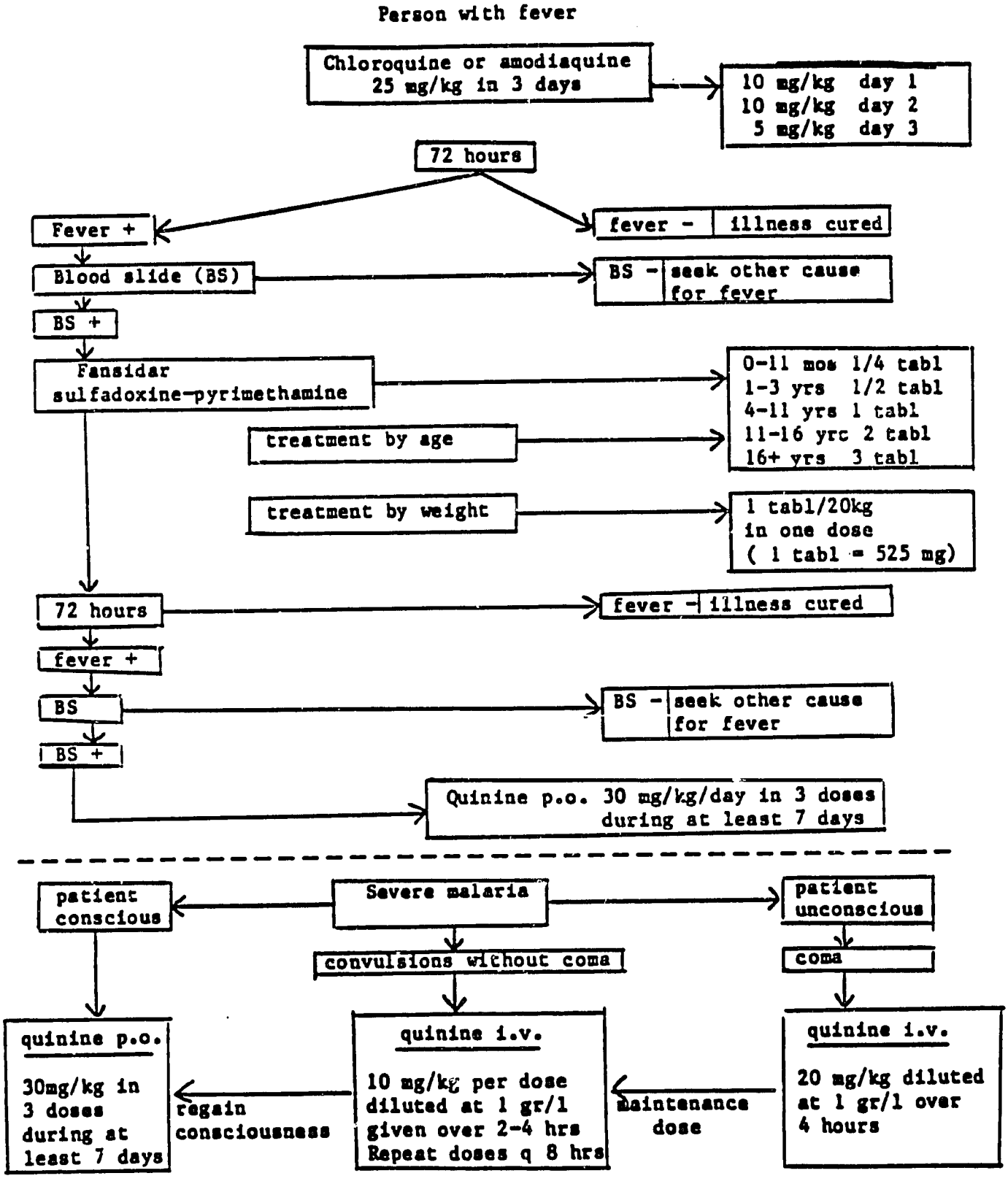


Key:
Referral ——▶
Feedback - - - -▷

Annex D

Algorithm for Treatment of Malaria

ALGORITHM FOR TREATMENT OF MALARIA



Annex E

Standardization of therapy

A. Treatment of mild to moderate malaria

All children under five who have fever or other signs and symptoms recognized by health personnel as malaria need to be treated with an appropriate dose of oral antimalarial, either syrup or tablet, unless severe vomiting or altered state of consciousness requires an injectable antimalarial. The current drug of choice for malaria is chloroquine in a dose of 25 mg/kg in three days. If the child cannot be weighed, treatment may be given as in Tables 1 and 2. Fever in many children will be due to other causes, such as measles, diarrheal diseases and upper respiratory infections. Presumptive treatment should be given to these individuals as well because of the high frequency of concurrent malaria infections. Every child with fever should be treated presumptively for malaria; those who have signs and symptoms of other diseases must be treated for these diseases as well.

Concurrent with presumptive treatment for malaria, children under five should be treated with aspirin by mouth in order to immediately decrease the fever until the malaria has had an effect (the dosages for aspirin by age are given in treatment table 3). In addition, highly febrile children should be given a sponge bath in which the body is wiped air dry. The sponge bath should be repeated as needed to lower the child's temperature.

A child with fever requires more than the normal amount of fluids, and mothers should be encouraged to provide extra breast-feeding and increased amounts of clean water or other liquids.

B. Treatment of severe malaria

Patients with severe malaria need to be hospitalized promptly. Severe cases can be treated according to the degree of severity either by chloroquine injection (IM) or by quinine IM or IV. However, among children less than five years old, the administration of quinine IV is preferred because of complications caused by use of quinine IM.

Parenteral administration should be stopped as soon as the patient can swallow.

Quinine by intravenous means:

- o Ten mg/kg a dose diluted with 1 gr/1 and administered over 2-4 hours.
- o Loading dose is 20 mg/kg if coma is present.
- o Subsequent doses: 10 mg/kg dose to be repeated every 8 hours according to need.

C. Treatment of chloroquine treatment failure

Patients who fail to respond to chloroquine treatment need to be seen in a hospital. The diagnosis needs to be microscopically documented and an accurate history of drug use obtained. If the case is considered to be chloroquine treatment failure, it needs to be treated with sulfadozine/ pyrimethamine (Fansidar). One tablet contains 500 mg sulfadozine and 25 mg pyrimethamine. For dosaging see therapy table 4.

D. Treatment of multiple drug-resistant P. falciparum

The following therapy is recommended for treatment of P. falciparum infections that appear to be resistant to chloroquine and sulfadozine-pyrimethamine:

Quinine 10 mg/kg three times per day for 7 days or, alternatively, quinine for 3 days in association with 7 days of tetracycline.

Therapy Table 1. Chloroquine 150 mg Base/Tablet Dose Table

Age group	Weight range (kg)	Day 1 Tablets	Day 2 Tablets	Day 3 Tablets	Total Tablets
6 months	3.4 - 7.4	1/2	1/2	1/4	1 1/4
6-11 months	7.5 - 9.9	3/4	3/4	1/4	1 3/4
1-3 years	10.0 - 14.4	1	1	1/2	2 1/2
4-6 years	14.5 - 18.4	1 1/2	1 1/2	3/4	3 3/4
7-11 years	18.5 - 34.9	2 1/2	2 1/2	1	6
12-15 years	35.0 - 59.9	4	4	2	10
16 years and >	60.0 and >	4	4	2	10

Therapy Table 2. Chloroquine 50 mg Base/5 ml Syrup Dose Table

Age group	Weight range (kg)	Day 1 ml	Day 2 ml	Day 3 ml	Total ml
< 6 months	3.4 - 7.4	7.5	7.5	5	20
6-11 months	7.5 - 9.9	10	10	5	25
1-3 years	10.0 -14.4	15	15	7.5	37.5
Older than 3 years	USE TABLETS AS PER THERAPY TABLE 1				

Therapy Table 3. 300 mg Aspirin/Tablet Dose Table

Age group	*Aspirin dose (300 mg tablets)
< 2 years	1/4 tablet every 4 hours
2 years	1/2 tablet every 4 hours
3 years	3/4 tablet every 4 hours
4-5 years	1-2 tablets every 4 hours

*Parents should give doses until the fever goes away, but not more than three days in succession. Prolonged fever could indicate other diseases. Another fever-lowering drug such as acetaminophen can be used in place of aspirin.

Therapy Table 4. Sulfadoxine-Pyrimethamine

Single dose treatment

Age group (years)	Dose (no tablets)
0-3	1/2
4-11	1
12-14	2
>15	3

Table 1. Ghana population by locality size, 1970

Population	Number of localities	Percentage	Population	Percentage
< 100	35,974	75.3	796,016	9.3
100-499	8,717	18.2	1,973,349	23.1
500-999	1,795	3.8	1,233,161	14.4
1,000-1,999	826	1.7	1,125,417	13.1
2,000-4,999	322	0.7	958,914	11.2
5,000-20,000	112	0.2	932,965	10.9
20,000-50,000	17	< 0.1	462,203	5.4
50,000 or more	6	< 0.1	1,078,473	12.6
Total	47,769	100.0	8,559,313	100.0

Source: UNICEF 1984 Ghana situation analysis

Table 2. Percent use of facilities for sick children

Type of facility	Rural		Urban	
	Number yes	% yes	Number yes	% yes
MOH hospital	1,042	11.9	1,000	22.4
Health center/post	1,046	10.4	1,009	25.4
Community clinic	1,048	13.4	1,011	4.9
Private hospital	1,048	6.5	999	4.3
Traditional methods	1,048	7.1	1,017	5.6
Self treatment	1,050	43.4	1,016	27.2
No medication (no help)	1,054	9.4	1,029	10.0

Source: Adjei S, et al. Primary Health Care Review, 1985

Table 3. Five top national reported diseases, 1987*

Diseases	Number of new cases	Percent
1. Malaria	1,141,893	42.8
2. Diarrheal diseases	219,798	8.2
3. Upper respiratory infection	212,548	8.0
4. Skin diseases and ulcers	120,829	4.5
5. Accidents	103,107	3.9
All other diseases	868,471	32.6
Total new cases	2,666,646	100.0

* Outpatient facilities

Source: Centre for Health Statistics

Table 4. Knowledge, Attitudes and Practices I
(N >8,000)

Causes of Malaria

Causes	Range of Responses
No response	2.1 - 2.5
Mosquito bite	12.4 - 49.1
Uncleanliness	1.5 - 18.1
Sunshine	2.5 - 37.0
Flies	0.1 - 6.5
Don't know	20.6 - 70.3
Headache	2.1 - 22.0
Other	0.1 - 7.2

Source: S. Adjei, 1985 survey

Table 5. Knowledge, Attitudes and Practices II
(N >8,000)

Treating malaria

Treatment	Range of responses
No response	5.2 - 5.8
Give chloroquine	14.1 - 45.2
Give paracetamol/aspirin	5.5 - 38.5
Give herbal treatment	7.7 - 39.1
Other medication	12.3 - 39.3

Source: S. Adjei, 1985 survey

Table 6. Knowledge, Attitudes and Practices III
(N >8,000)

Suggestions on how to prevent malaria

Suggestions	Range of responses
No response	0.3 - 15.2
Cleanliness	5.9 - 53.2
Use net/avoid mosquitoes	1.9 - 17.7
Take drugs	1.7 - 14.3
Avoid sunshine	1.1 - 21.3
Government to provide medicine	1.3 - 13.5
Don't know	15.4 - 59.0
Other	3.1 - 8.2

Source: S. Adjei, 1985 survey

Annex G

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Annex H

The Control of Malaria Vectors in the Context of the Health for All by the Year 2000 Strategy

ARTICLES

THE CONTROL OF MALARIA VECTORS IN THE CONTEXT OF THE HEALTH FOR ALL BY THE YEAR 2000 GLOBAL STRATEGY

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ABSTRACT. The changing picture of malaria worldwide needs to be viewed in the context of other developments before we can determine the directions to take to be able to provide the thrusts required in malaria vector control. As a result of population growth, increasing urbanization and continuing pressure on scarce natural resources, the epidemiology of malaria and its manifestation as a public health problem are undergoing profound modifications, indeed in several parts of the world. This picture is further complicated by the spread of resistance to pesticides in the vector and to drugs in *Plasmodium falciparum*. In the immediate future, these trends will continue. In addition, the appearance of suitable vaccines is a highly probable event to be taken into consideration.

The WHO Global Strategy of Health For All by the Year 2000 aims at the improvement of levels of health through primary health care. Among other things, this implies a greater reliance on community involvement and on intersectoral collaboration for health.

In this light, the major malaria problems in the year 2000 will be: (1) "hard core" endemic areas with inadequate infrastructure and poor socio-economic development; (2) resource development areas, in particular those under illegal or poor controlled exploitation; (3) expanding urban areas and (4) increased mobility of non-immunes, particularly if uncontrolled.

In order to cope with these problems, thrusts are required towards the development of vector control strategies, covering the following fields: (1) tools for vector control integrated in primary health care, (2) new chemicals, (3) improved and new biologicals, (4) environmental management and the adoption of health safeguards in resource development projects and (5) manpower development.

INTRODUCTION

The title of this paper implies that we look ahead and try to determine the directions that need to be followed in malaria vector control in future years. These considerations need to take the dynamics of disease transmission into account as well as the expected developments in respect of approaches to its control. Overall environmental and social trends must be viewed as setting the stage for future changes in malaria epidemiology and control issues. This approach is reflected in the layout of this paper into five, increasingly specific, parts.

GLOBAL TRENDS

By far the most influential trend at the global level is population growth. Between 1980 and 2025, the world population will almost double to a total of more than 8 billion (United Nations 1985). The greatest growth is due to take place in the less developed countries, in most of which malaria is either endemic or in some state of control, requiring continuous action. Population growth therefore is a multiplier factor for inputs needed for malaria control.

The degree of urbanization, already quite staggering in some parts of the world, is bound to increase in most continents. Latin America, already the world's most urbanized continent in 1980, will have 466 million people, or 75%, living in cities in 2000. The number of people in cities of more than 5 million inhabitants will increase even more sharply. Although this phenomenon will be most apparent in Africa, in concrete terms Latin America will have the largest portion of its population in such cities by 2000: 147.5 million, or 23.8% (United Nations 1985).

It is a well-known fact that non-renewable natural resources are already under severe stress from over-exploitation today. If current trends continue, the situation will no doubt deteriorate further, affecting the lives of more and more people. As an example, more than 11 million hectares of tropical forest is lost annually worldwide (United Nations (FAO) 1982). Arable land being brought under irrigation is bound to increase with 75 million hectares between 1985 and 2000, 15 million hectares of which will be added in India alone. The total world reserve of

[1] Presented at the 52nd annual meeting of the American Mosquito Control Association, Seattle, Washington, March 30, 1987.

potentially arable land will decrease from 24% of total land surface in 1981 to 22% in 1994.[2]

With these and other well-known examples in mind we can describe a number of global trends, which are extremely relevant for the epidemiology of malaria and for the approaches needed for vector control:

The numbers of people affected and their life expectancy will go up.

The rate of urbanization will go up as well, which means that more rural land will be turned into urban areas, more people and larger proportions of total populations will live in cities, there will be more giant cities (i.e., cities with at least 5 million inhabitants) and slum areas are bound to increase as a consequence.

People will be increasingly mobile, either for political, economic or touristic reasons. This will increase the mobility of pests, vectors and pathogens, resulting in the increased exposure of non-immunes to inoculations with vector-borne diseases.

With natural areas dwindling, we will see a world with less forest and hence fewer people living in forested areas, less non-cultivated arable land and less water per capita. The reduced availability of water will put drinking water and sanitation programs under pressure and it will force industry and agriculture into adopting production practices that consume less water.

On the bright side, with increasing levels of education we may expect improvements generally in hygiene and the adoption of more healthy life styles. Another benefit of increased literacy will no doubt be the greater availability of suitable human resources for health programs, particularly primary health care. There will indeed be an increasing need for the implementation of the Global Strategy of Health For All, through primary health care, as the only reasonable and feasible approach to the attainment of better health for populations at large. With reference to malaria control, this observation will lead us to greater emphasis on the involvement of individuals and communities towards effective self-protection, vector control and source reduction through environmental action (World Health Organization 1986).

Needless to say, the Health For All Strategy, adopted by the World Health Assembly in 1981, will need to be continuously adjusted at country level to ensure the most appropriate use of resources in a very dynamic world. After having taken a look at some very specific trends in malaria in the next section, I will try to outline what this statement may entail for the control of this disease in the section following it.

TRENDS IN MALARIA

Resistance to insecticides in the anopheline mosquitoes is already a severe problem in several areas of the world. Although there are no instances known where the vector has become resistant to all available insecticides, resistance often brings with it the need for more expensive alternative compounds and thus tends to raise the cost of vector control. Insecticide resistance is bound to spread further to more vector species, encompassing a wider range of compounds.

Without incentives to industry and research groups it is doubtful that the development of new compounds will be stepped up. At present, only a few compounds are offered to the WHO Pesticide Program (WHOPES) for testing each year and an even more precariously low number of these subsequently qualify for use against malaria vectors.

A rather similar situation seems to apply to the development of drug-resistance in the parasite (only *Plasmodium falciparum* being involved so far) and the availability of alternative drugs for prophylaxis and treatment. On the other hand, it is almost certain that by 2000 there will be operational vaccines against malaria (against sporozoite and/or merozoite antigens and/or transmission-blocking), currently being developed with assistance from the World Bank/UNDP/WHO Special Program on Research and Training in Tropical Diseases (TDR).

With the shifts in population from rural areas to the cities, urban malaria, until recently a rather insignificant phenomenon in limited areas of the world, will become more important as peri-urban areas will increasingly provide some vectors with a transitional habitat with suitable breeding places and abundant hosts. On the other hand, "jungle" malaria, with its technical and operational difficulties for control will become less and less important as areas will get deforested and people will move away. The net effects of these changes will depend on many factors and may hence be difficult to predict. It seems justified, however, to assume that in Asia east of India the overall malaria incidence may ultimately even be reduced, but in India and in Africa south of the Sahara the outlook is definitely more pessimistic.

MALARIA RISKS IN THE YEAR 2000

On the basis of the observations made in the preceding sections, we might attempt to identify

[2] Winrock International. 1985. World agriculture: Review and prospects into the 1990s; a summary. (Unpublished report). Winrock International, Morrilton, Arkansas. April 1985.

what will be the most severe malaria risk situations in the year 2000. This is in itself a risky undertaking as the future cannot be forecasted with more than approximate precision. However, some of these risk situations are presently already seen to emerge and it is not difficult to extrapolate from them what consequences they might have in the longer term. A number of these are the following:

Endemic areas with inadequate infrastructure, already existing today, will persist for a sufficiently long time to represent the "hard core" of the traditionally malarious areas where little can be done to relieve the situation. Although considerable progress is expected in the provision of diagnosis and treatment, through primary health care (World Health Organization 1986), some of these areas will persist up to the year 2000. They will be concentrated in Africa south of the Sahara, southern Asia and parts of the western Pacific.

Natural resource development areas, particularly those under uncontrolled or illegal exploitation do already present a high risk and this will be increasingly true in the future. As these areas are being opened up and as they expand, they bring people with widely different malaria exposure experiences, including parasite carriers and non-immunes together in an environment which is conducive to an increased production of vector mosquitos, often in the absence of adequate infrastructural facilities for diagnosis and treatment, let alone vector control or source reduction. A different class of resource development activity is formed by government-initiated, often large-scale, projects for irrigation, hydropower generation or other purposes. These are often being planned and carried out without health safeguards being considered. The detrimental results on malaria incidence has in some instances led to considerable delays, to increased costs and to human suffering, all of which could have been avoided by appropriate action. Unless financing agencies and governments adopt health safeguards as essential components of such projects, these will form an added malaria risk in several less developed countries in the years to come.

Expanding urban areas do already form increasingly important risk areas in several countries as the originally rural breeding habitats become surrounded by urban sprawl areas and shanty towns. Typically, when such areas become more and more densely built up the conditions favoring anopheline breeding will gradually diminish and other health risks (dengue, DHF, lymphatic filariasis, plague) may arise, while malaria may remain prevalent in the expanding urban fringe.

Mobile non-immunes, already mentioned under the subject of resource development, form a risk group particularly prone to contract the disease in an endemic environment. If travellers, whether immune or non-immune, return to their places of origin they may contribute to the spread of parasites or of unfavorable parasite genes (drug resistance).

CONSEQUENCES FOR VECTOR CONTROL

Traditionally, vector control has been the main tool for the reduction of malaria transmission in endemic areas. In the malaria eradication era, residual house spraying with insecticides was considered indispensable for achieving the low levels of transmission where surveillance through active and passive case detection could reduce the incidence of the disease further. It is obvious that this philosophy will be rather inadequate in dealing with the problems outlined above. Residual house spraying will always have a role to play in areas where this method is useful, feasible and affordable, as long as an effective and safe insecticide is available. In some areas, notably in some cities, larviciding may have to be considered instead. In yet other situations, completely new approaches may be necessary. It ought to be realized that in areas of drug-resistance, vector control may contribute to prolonging the effective life-span of alternative drugs and might be applied just for that purpose. The consequences of the trends and risks described in the preceding sections fall into five broad categories: self-protection, adulticides, larvicides, source reduction and vector manipulation.

Self-protection. At the level of the individual, chemoprophylaxis and other measures for self-protection form powerful tools in the prevention of malaria. Mass chemoprophylaxis is not considered appropriate methodology for widespread application at the community level. Indeed, the popularity of chloroquine as a household drug for prophylaxis and treatment throughout many areas in Asia and Africa has been a major factor in the selection of drug-resistant *P. falciparum*. As we may expect these considerations to remain valid for some time to come, chemoprophylaxis will mostly be recommended for selected groups at risk, e.g. migrant workers, tourists, pregnant women. Other approaches should be used in addition. The reduction of man-vector contact through clothing, screening, netting, the use of repellents and/or insecticides, either solely or in combination, is a feasible and appropriate option in many situations. Clothing, bednets and curtains impregnated with pyrethroids have demonstrated their value in various parts of the world. As was shown in the Solomon

54

Islands, bednets can be impregnated with permethrin at village level under the guidance of a primary health care worker and it is now one of several tools in the integrated control of malaria in that country. Similarly, headbands, wristbands and anklets impregnated with DEET could be effectively applied by tourists or migrant workers travelling in endemic countries. Mosquito coils, already quite popular in many tropical countries, could be further promoted and made available at considerably lower cost. Housing improvements that reduce access of mosquitos to the occupants, such as screening of windows and doors or the replacement of ratan and bamboo by more solid materials for walls and floors, will have a major impact on malaria transmission if rigorously promoted and carried out under trained supervision. Evidently, a number of measures for self-protection requiring a minimum level of socio-economic development and basic facilities for primary health care, cannot and will not solve the malaria problem everywhere. All that is being argued is that each measure has its proper place and that we must be imaginative and flexible to cope with an increasingly complex situation.

Adulticides. Next to the "traditional" role of adulticides as residual insecticides, such as DDT, HCH, malathion, fenitrothion and others, there will be an increasingly important place for household applications like fumigant cannisters, knock-down aerosol sprays, etc., which individuals can use at home as part of self-help or community participation programs. Again, these applications require a certain level of socio-economic development. There must also be safeguards for their judicious use, both in terms of human safety and in terms of effectiveness, which implies minimal levels of literacy and well-trained primary health care workers.

Residual insecticides will have a place in malaria control for many years to come.

Larvicides. Traditionally, larvicides have always had a role to play in malaria control wherever the use of residual adulticides was either impractical or not cost-effective. Although this is bound to remain valid in the medium-term, larvicides may be especially useful in situations where they can be part of community participation programs for integrated vector control. The overall objective being to reduce vector densities, emphasis will sometimes be on permanent environmental measures rather than larvicides, depending on the local situation.

Source reduction. As much legal and government-controlled resource development in endemic countries entails migrations of non-immunes into areas with temporary housing and the potential risk of extensive vector breeding in habitats with poor infrastructures, the incorporation of environmental measures directed at source reduction will be of crucial importance in the prevention of malaria associated with such activities. In many other situations, source reduction, as a more permanent measure with durable results, may also be the method of choice. It is a critical feature of environmental management that it is based on a clear understanding of the local ecology and the epidemiology of the disease and, as is the case with other control approaches, it must always be cost-effective in comparison with other methods.

A special case for source reduction will be presented by the vast peri-urban and urban areas where poor drainage and the proximity of breeding places to residential areas will provide the conditions necessary for the transmission of malaria in some of the cities of tomorrow. Popular support for insecticidal spraying usually being poor in urban areas, such environmental measures will depend heavily on initiatives taken by municipalities, community participation being mainly through the payment of taxes or other contributions towards financing.

Vector manipulation. This term may be used to describe measures aiming at transmission control through the vector, without necessarily controlling the vector. The use of the cytoplasmic incompatibility technique for culicine control is a proven possibility. It is equally possible to apply a similar approach to the control of malaria and other human vector-borne diseases, but the methods involved have so far proved to be too costly and too complicated logistically to be of practical use. Similarly, genetic manipulation techniques aiming at increasing the frequency of refractory genes in the wild population, though technically feasible, have never been applied at the field level. Manipulating nature in a well-defined manner apparently is still beyond human capabilities. This situation may change in future if more becomes known about the molecular basis of host-parasite relationships and their genetic determinants. An exciting possibility for interference with vectorial potency through the introduction of symbionts, or competitive parasites, still needs to be explored. Methods like these may be of extreme value in areas where other vector approaches fail for lack of infrastructure or community support. Parts of the "hard-core" problem areas, still expected to be of importance in the year 2000, could benefit most if such control measures were to become operational.

MAJOR THRUSTS REQUIRED

Having had a speculative look at future trends and vector control needs, it now remains to assess these in the light of present-day knowl-

edge and experience to see in what areas vector control research and development should be expanded and strengthened. These areas include at least the following:

Primary Health Care involvement. Although a number of tools for vector control in Primary Health Care already exist, we generally lack know-how as to how to promote their utilization. At the general health services level, public health officers are not always aware of the merits and the cost-effectiveness ratios of many available vector control methods. At the community level, people often fail to see the relationship between vector prevalence and disease or to appreciate the potential of control and prevention for the amelioration of the quality of life. Primary Health Care workers, if they are available, often lack the understanding or the specific training required to effect the necessary changes. Major target areas for operational research and training in this field should be: (1) self-protection, (2) housing improvement and (3) environmental management/source reduction.

Development of new pesticides. As there will always be a need for appropriate pesticides, the present situation gives rise to concern. The number of alternative insecticides for malaria control is not being increased as it should, although some interesting new compounds are under trial. A major effort will be required in the following areas: (1) new generations of compounds, (2) new formulations of existing compounds and (3) household applications.

Development of new biologicals. Biological control agents for malaria vectors need to be found to complement larvivorous fish, which form the major group of such agents at the moment. Although a great many potential agents have been identified, few of these have so far been developed to the operational stage. The potential for vector manipulation, alluded to in the foregoing paragraphs, has not even been touched. It is evident that major thrusts are needed in (1) further development of existing biologicals, (2) identification of new generation biologicals and (3) vector manipulation.

Environmental management. More operational research and training in environmental management will be needed in three major areas: (1) water resource development projects (i.e. health safeguards), (2) urban vector control and (3) community participation.

Manpower development. Major efforts will be required to solve the vector control manpower problems world-wide. Not only do we face a severe shortage of trained specialists who can handle the very complex situations arising as a result of more adaptable strategies for malaria control and the spread of insecticide resistance, there is also a great need for trained technicians and, most of all, primary health care workers who can deal with vector control issues at the community level.

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Annex I

Combating Severe Malaria in African Children

Research
Recherche

Bulletin of the World Health Organization, 66 (5): 611–620 (1988)

Combating severe malaria in African children*

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An initiative to reduce childhood mortality due to malaria, diarrhoea and vaccine-preventable diseases, called the Africa Child Survival Initiative—Combatting Childhood Communicable Diseases (CCCD) project, was started in 1982 and is now operating in 13 African countries, 12 of which are endemic for malaria. The project's malaria control strategy relies on the use of drugs, mainly chloroquine, to prevent severe illness and death in children less than 5 years of age; chemoprophylaxis for pregnant women is also advised to prevent low birth weight in newborns. The strategy is based on WHO recommendations which focus on improved diagnosis and treatment of cases and chemoprophylaxis for pregnant women.

In 9 out of the 13 CCCD countries the sensitivity of Plasmodium falciparum *to chloroquine in children was investigated and a drug sensitivity surveillance network was established. In areas with chloroquine-resistant* P. falciparum, *treatment with chloroquine was found to decrease the temperature in febrile children and to greatly reduce the parasite density, thus preventing severe illness and possible death. Baseline surveys in 6 countries have shown a wide range of treatment practices, e.g., use of chloroquine in various doses without standard guidelines and the excessive use of quinine and chloroquine injections in some health units. As pregnant women are often not taking chemoprophylaxis, research has been started on alternative approaches to drug treatment to prevent the adverse effects of malaria on the fetus.*

Only 4 of the 12 malarious countries had malaria control units when their CCCD programme began and these were concerned mainly with vector control issues; 11 of 12 countries now have such units and a written CCCD malaria plan. These countries have now integrated malaria control activities into primary health care and have begun to implement standardized treatment and prevention practices that are described in their national CCCD malaria plans.

INTRODUCTION

Malaria remains one of the most widespread infectious diseases in Africa. Over 90% of the 450 million persons in Africa south of the Sahara live in malarious areas. The epidemiology of malaria transmission and disease varies greatly and depends on topography, rainfall, and human behaviour. The prevalence of *Plasmodium falciparum* infection in endemic areas is frequently over 50%, with the highest rates occurring in children (*1*). In most communities the incidence of acute illness is difficult to measure because of the imprecision in clinical diagnosis and lack of microscopic confirmation. About 3 to 10 million cases are reported annually by countries in the WHO African Region (E. Beausoleil, personal communication, 1987), but because of incomplete and irregular reporting these data are of limited value. WHO considers that 80% of the 100 million cases of clinical malaria occurring in the world each year are from Africa south of the Sahara (*2*). The risk of severe and potentially fatal *P. falciparum* infection is greatest in

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persons with little or no acquired malarial immunity, such as young children and immigrants from malaria-free areas. Immunological changes during pregnancy appear to be associated with a higher frequency of malaria infection during the pregnancy and with low-birth-weight newborns in women with parasites in the placenta.

Attention to priority groups using selective interventions for African populations has been stressed repeatedly by WHO since 1962.[a] Numerous WHO meetings and documents have drawn attention to the necessity for prompt diagnosis and treatment of malaria, chemoprophylaxis for pregnant women, and selective use of vector control measures, and the need to create specialized malaria units at the central level and to involve the general health services (and subsequently community health workers) in antimalaria activities (*3–6*).[b]

These recommendations have formed the basis of evolving malaria control strategies. However, one striking paradox is that although Africa south of the Sahara is the most intensely malarious area in the world, it was not included in the global malaria eradication efforts of the 1950s and 1960s. As intradomiciliary insecticide spraying was not feasible in much of Africa, it was considered that malaria control in Africa was too difficult, costly, and ultimately, not achievable since eradication efforts in other regions also had failed. Certainly, few tangible examples of effective national malaria control in Africa south of the Sahara are available for emulation by other countries. Hence, cost-effective measures against malaria have not been promoted actively by many African public health authorities.

A series of fresh initiatives for malaria control are now in progress, derived from WHO strategies that were developed as the objectives shifted from eradication to control. These approaches and actions have been developed because it is now realized by the African nations and international collaborators that the intolerable burden of severe illness and death due to malaria in Africa can be substantially reduced by the judicious use of available drugs (*3–6*),[c,d] even in the most remote areas of the continent and where chloroquine-resistant *P. falciparum* (CRPF) parasites are transmitted.

The aim of the Africa Child Survival Initiative—Combatting Childhood Communicable Diseases (CCCD) project, which was started in 1982, is to strengthen national capacities to control severe illness and death due to malaria, diarrhoea and vaccine-preventable diseases. The CCCD is currently operating in 13 African countries with a total population of 170 million (Fig.1). Their malaria strategies are: (1) to ensure prompt and effective treatment of high-risk groups with malaria (e.g., children less than 5 years of age and pregnant women); (2) to control malaria infection in pregnant women by prophylactic drug use, principally to reduce the risk of low-birth-weight infants and, thereby, improve child survival; (3) to maintain surveillance on malaria treatment and prevention practices by monitoring the clinical and parasitological response to therapy and the patterns of severe illness and death; and (4) to develop national malaria control plans with detailed guidelines for their implementation and evaluation. To promote successfully these strategies it is necessary to develop malaria expertise in the various ministries of health as well as at the peripheral levels of health care delivery; ideally, a special unit would be responsible for collecting and disseminating information on malaria, for training, and for coordinating with other health sectors locally, nationally and internationally.

For an effective programme, several key issues must be addressed in the field, including therapy, delivery of services, malaria control during pregnancy, health education, and measurement of impact. Progress in these CCCD malaria activities are reviewed in this paper.

DEFINITION OF EFFECTIVE THERAPY

Since the late 1970s, chloroquine-resistant falciparum malaria has become an increasingly prominent

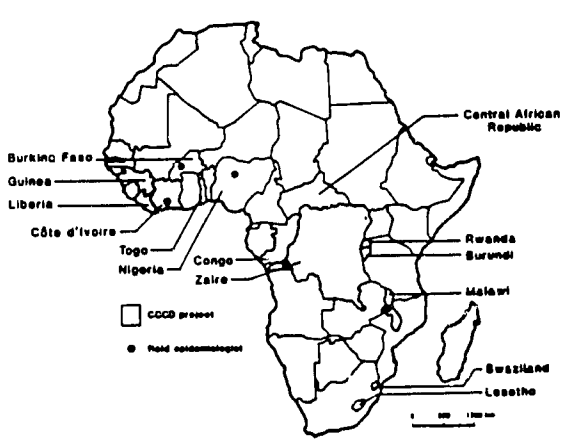

Fig. 1. Countries with CCCD (Combatting Childhood Communicable Diseases) activities in Africa, 1987.

[a] WORLD HEALTH ORGANIZATION, *Report of the Third African Malaria Conference, Yaounde, 1962* (unpublished).

[b] Resolution on regional antimalaria strategy adopted by the WHO Regional Committee for Africa (AFR/RC31) in 1981.

[c] U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT. *Manual on malaria control and primary health care in Africa, Washington, DC, 28 June–2 July 1982* (unpublished).

[d] U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT. *Proceedings of a Malaria Strategy Workshop, Columbia, MD, June 1983* (unpublished).

epidemiological feature in Africa (*7*). Were it not for decreased parasite sensitivity, chloroquine would have been the ideal drug for treating malaria because it is relatively inexpensive, acts rapidly to decrease the parasite density and symptoms, and is well tolerated. Traditionally, the goal of malaria therapy was complete elimination of the parasitic infection. However desirable this may be, the primary objective is to reduce the frequency of severe illness and death by prompt therapy. Where malaria reinfection is likely soon after treatment, as in most areas of the CCCD countries, it has been demonstrated that it is not necessary to eliminate the parasitaemia completely to achieve a reduction in malaria morbidity (indicated by decrease in fever) (*8*) and mortality (*9*).

The results of *in vivo* drug-sensitivity surveillance studies performed by the CCCD malaria units in children since 1982 are shown in Table 1. The objective of drug-sensitivity surveillance is the provision of information that can be used to establish and monitor treatment regimens. Minimum data required include the clinical response to treatment (essentially a reduction in fever) and decrease in parasitaemia. For this, a simplified version of the WHO *in vivo* drug-sensitivity test (*10*) has been developed and requires only 2–3 follow-up visits (*8, 11*). *In vitro* assessments have been performed infrequently, and almost always by consultant teams. *In vitro* testing has been de-emphasized because the data collected are less useful for operational decision-making, and the method requires laboratory staff to do this work regularly in order to maintain their skills, using reagents and materials that are expensive and not readily available. *In vitro* testing will be used on a limited basis for quantitating the parasite response to chloroquine and to potential alternative compounds and only as an adjunct to *in vivo* testing.

Occurrence of CRPF infection has been reported in 9 of the 12 endemic countries, namely, Burundi (*12*), Central African Republic (*13*), Congo (*14*), Malawi (*8*), Nigeria (*15*), Rwanda (*16*), Swaziland (D. Heymann, personal communication, 1985), Togo (*17*) and Zaire (*18*). *In vivo* assessments of the therapeutic efficacy of chloroquine at a dose of 25 mg base/kg body weight in countries with CRPF has revealed that 22–57% of children under 5 years of age will remain parasitaemic on the seventh day following initiation of therapy. Most of the resistance is of the intermediate (RII) type. Of critical importance is that children treated with chloroquine have, on the average, a 98% reduction in their initial parasite density, and over 90% of those who are febrile initially improve clinically, as noted by clinicians and parents, or as indicated by a decrease in the temperature to normal (*19, 20*) (M. Pappaioanou, unpublished observations, 1986). In two West African countries,

Table 1. Results of chloroquine-sensitivity studies carried out by the CCCD project teams, 1983–1987

				Chloroquine dosage (base)			
				10 mg/kg		25 mg/kg	
Country	Year	No. of sites	Age group (years)	No. treated	No. successful[a]	No. treated	No. successful[a]
Zaire	1983	2	6–14	43	43 (100)[b]	66	66 (100)
	1985–86	7	0–4	271	167[c] (64)	259	163 (63)
Malawi	1984–85	6	0–4	26	4 (16)	244	97 (43)
Togo	1984–85	3	0–4	178	174 (98)	—	—
Swaziland	1985	1	0–4	35	23 (66)	—	—
Congo	1985	2	3 months–5	54	10 (18)	92	49 (53)
			6–12	270	105 (39)	73	57 (78)
Rwanda[d]	1986	2	0–4	—		44	19 (43)
Côte d'Ivoire	1986	2	6 months–4	109	108 (99)		
Central African Republic	1986	1	0–4	—		57	54 (95)
Nigeria	1987	2	6 months–4	—		80	52[e] (65)

[a] Success defined as no parasites detectable on day 7 post-treatment.
[b] Figures in parentheses are percentages.
[c] Only the 10 mg/kg dosage was tested at one site and 86/93 (92%) were successful at this site.
[d] Dosage of 50 mg/kg divided over 5 days was given to another group; 23 out of 49 children so treated were succesful (47%).
[e] At one site 36 children all responded successfully.

Togo (*10*) and Côte d'Ivoire (B. Soro, personal communication, 1986), a single dose of chloroquine at 10 mg/kg eliminated the parasites from over 99% of children by day 7 and led to a decrease in temperature in febrile children. However, as CRPF is likely to spread throughout all of Africa south of the Sahara within a few years, the single-dose treatment of 10 mg/kg is no longer recommended by the CCCD project. A dose of 25 mg/kg given over 3 days (10 mg, 10 mg, 5 mg) is advised, as recommended by WHO (*6*).

Drug-testing surveillance in 9 countries (Table 1) provided data supporting a decision to continue using chloroquine as the primary treatment for uncomplicated childhood malaria, even though alternative therapies like amodiaquine and pyrimethamine/sulfadoxine (Fansidar)[e] produced higher rates of parasitological cure (*21, 22*) (O. J. Ekanem, unpublished observations, 1987). This strategy was adopted mainly because of the continued clinical effectiveness, safety, and low cost of chloroquine.

It has been contended that the continued use of chloroquine in Africa will hasten the selection of more resistant strains of *P. falciparum*. This may be true for chloroquine. Likewise, it is inevitable that resistance will also develop to the alternative drugs if these are used on a wide scale. Consequently, priority must be given to continued use of the 4-aminoquinolines for as long as they retain clinical and parasitological efficacy and while there is no other equally safe and cheap drug. At the same time, unnecessary drug use that could promote resistance should be restricted; these practices include the use of antimalarials for non-febrile illnesses, underdosing, wide-scale chemoprophylaxis, or excessive use of antibacterial compounds such as the antifolate combination trimethoprim/sulfamethoxazole, an antibacterial formulation related to pyrimethamine/sulfadoxine.

The development of specific diagnostic criteria and indications for therapy is important for preserving the efficacy of antimalarial drugs as well as for preventing progression to severe illness. *Plasmodium* parasitaemia is not a *sine qua non* for initiating treatment because microscopy, which is required traditionally for a diagnosis, is impractical in most of Africa. The child's clinical status must be the deciding factor in determining if malaria therapy is appropriate, and whether oral or parenteral treatment is needed. The following clinical indicators have been used in evaluations of the response to chloroquine therapy of children in CCCD countries with CRPF: neurological status, fluid balance, temperature, and the subjective impressions of parents and clinicians. The best indicators for diagnosing malaria and following the clinical response to treatment are a history of recent fever and a measured rise in body temperature (M. Pappaioanou, unpublished observations, 1986). Recently, hypoglycaemia has been shown to be a risk factor for severe (including cerebral) malaria and death in African children (*23*). Very ill patients require special clinical care following established guidelines (*24*).

In Africa, antimalarial therapy is usually dispensed or taken on the basis of the clinical illness alone (usually fever), and a more specific diagnostic criterion is not likely to be available in the near future. From a practical standpoint, malaria therapy should be given to all children with fever or a history of recent fever, who live in areas where the parasite prevalence is high and where transmission is intense. Certainly, some children will be treated for malaria when their illness is due to another cause. Yet, in this malarious environment, some degree of overprescribing is acceptable if this ensures prompt and appropriate treatment for a high proportion of children with malaria. Treatment, whether given at a health unit by a village worker or at home by a parent, should follow a precise dosage regimen so that every child will get the maximum benefit from the drug given.

Only limited data exist to show that the continued use of chloroquine in areas with CRPF can control morbidity and mortality. In Zaire, only 1 (2%) of 51 children with malaria who were febrile ($\geqslant$37.5 °C axillary) continued to have fever even 7 days after chloroquine treatment, while 14 (28%) were still parasitaemic (*19*). In one Indonesian village with 900 persons where only chloroquine was used for treatment, 17–47% showed *in vivo* resistance (depending on the dose used), most of which was at the RII level, and 90% of the *P. falciparum* strains tested *in vitro* showed resistance. Among 300 children under 10 years of age, none of the 201 with a *P. falciparum* infection who were treated with chloroquine died during 16 months of observation. Increasing the treatment dose from 15 mg/kg to 37.5 mg/kg was reported to be the probable cause of this success (*9*). In Burundi, however, an increase in the treatment dose from 25 mg/kg to 50 mg/kg did not confer a clinical advantage or improved parasite clearance (*20*). Although the drug and dosage are obviously important, the development of a surveillance system to identify failures and the establishment of criteria for switching to alternative doses and drugs are the key elements for a satisfactory treatment programme. At present, the criteria for changing from one drug to another are arbitrary and depend on economic as well as clinical and epidemiological factors.

[e] Use of trade names is for identification only and does not imply endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

DELIVERY SYSTEMS FOR MALARIA CONTROL

For effective and prompt treatment of children with malaria, both the right drugs and the knowledge of how to use them must exist in the community. The CCCD project has attempted to assess current practices with respect to malaria diagnosis and therapy as an initial step in developing effective and locally appropriate delivery systems for antimalarial drugs.

Surveys have been conducted in several CCCD countries to determine the percentages of recent febrile illnesses in children, whether they were treated and where, and whether an adequate drug and dosage were used. In some countries the mothers were asked if they had taken chemoprophylaxis for malaria during their most recent pregnancy. A varied picture of drug availability and use emerged, depending on the local epidemiology of malaria, provision of drugs by the government or private sector, previous treatment practices, and training of health service providers.

While the frequency of febrile illness in the two weeks prior to the survey was relatively similar, ranging from 15% to 35% and indicating that at least 4 and up to 9 febrile episodes occurred per child per year, the percentage who received drug treatment and the promptness of treatment varied widely (Table 2). In rural southern Togo, treatment was usually given at home using chloroquine that was often purchased from street vendors who are found in every village.[f] While the children were treated promptly, underdosing was common, 71% receiving less than the (at that time) recommended dose of 10 mg/kg of chloroquine base during the first 24 hours of treatment. In the Congo, Rwanda, and Zaire the treatment was more often obtained from the health units.

In Rwanda, however, half the children remained untreated after a febrile episode.[g] In rural Guinea, febrile episodes went largely untreated because mothers seldom took their children to the health centres or treatment was at home, probably because of periodic shortages of chloroquine (M. S. Deming, personal communication, 1985). In the capital, Conakry, chloroquine was used frequently, but only 53% of treatments lasted 4 or more days and were given in doses that generally were in excess of 40 mg/kg (J. G. Breman, unpublished observations, 1986). Although chloroquine was widely available in many areas of Zaire, a variety of drugs and dosages were used at the health units, where most children were taken for treatment.[h] In Burundi, Rwanda and parts of Zaire a 5-day treatment regimen of 50 mg/kg was recommended routinely before the beginning of the CCCD programme; no evidence is available that this dose is more effective than 25 mg/kg, the dose advised by WHO (*6, 20*). When the CCCD programme began in Togo, two-thirds of the health workers gave injections of quinine for the treatment of malaria, even if the patients could take medicines by mouth. In Conakry, Guinea, 47% of children received quinine injections for treatment of malaria at health units.

This heterogeneity of practices, termed "malaria treatment anarchy" by one prominent African health officer, is the result of obsolete training in therapeutics at some nursing and medical schools, acceptance of recommendations from outdated text-

[f] DEMING, M. S. ET AL. The adequacy of home treatment of malaria, Togo, West Africa, 1985. In: *Abstracts of papers presented at the Epidemic Intelligence Service Conference, Atlanta, Georgia, 22–26 April 1985.* Atlanta, 1985 (Centers for Disease Control), p. 30.

[g] DEMING, M. S. Malaria treatment coverage, Rwanda. In: *Abstracts of papers presented at the Epidemic Intelligence Service Conference, Atlanta, Georgia, 14–18 April 1986.* Atlanta, 1986 (Centers for Disease Control), p. 84.

[h] GOVERNMENT OF ZAIRE. *Combatting childhood communicable diseases: 1985 annual report.* Kinshasa, 1986 (Ministry of Health internal technical report).

Table 2. Use of antimalarial drugs by parents of febrile children in six CCCD countries, 1983–86

Country	No. of surveys	Percentage with a recent febrile illness[a]	Treated with antimalarial drug (%)	Treated only at home (%)	Treated within 24 hours (%)
Central African Republic	2 (>141)[b]	—	71	69	61
Congo	4 (709)	30	89	54	61
Guinea	2 (899)	14	19[c]	15	14
Rwanda	2 (528)	—	47	20	—
Togo	3 (4687)	34	84	72	84
Zaire	8 (11 489)	30	47	27	—

[a] Fever present in the two weeks prior to the interview.

[b] Figures in parentheses are the numbers of children in the surveys.

[c] Could be lower than 19% because specific treatment at the health centre is not known.

books, drug company promotions, health staff's and patients' preference for injections, irregular supplies of medicines at treatment centres, and lack of guidance from public health officials. With systematic national and local assessment of treatment practices, coupled with drug sensitivity surveillance and information transfer to practitioners, as well as training, the situation can change to one that offers cost-effective treatment for acute uncomplicated malaria.

While malaria therapy will not diminish the risk of infection in most parts of Africa because of intense transmission, it can be highly effective in controlling the symptoms and illness in the CRPF areas. Some clinical and parasitological treatment failures will require a well-defined referral plan for evaluation and treatment (*6, 24*). In addition, a small proportion of children will be seen who are too seriously ill to be treated at the community level and will require parenteral therapy. Communities should have clearly established links with the health facilities where effective parenteral antimalarial drugs and resources for clinical and laboratory diagnosis and treatment are available.[i]

MALARIA CONTROL IN PREGNANCY

Chronic or repeated *P. falciparum* infections of the placenta can lead to low birth weight, a major risk factor for increased childhood mortality (*25*). In areas of intense malaria transmission, these effects of malaria are seen mainly in primi- or secundigravida women (*26, 27*). To prevent the complications of malaria in pregnancy WHO has recommended that pregnant women should take preventive doses of chloroquine, particularly during their first and second pregnancies (*6*). This recommendation has been shown to be difficult to implement and may not be as effective as thought previously. First, it has proved exceedingly difficult to attain high levels of compliance, even in highly motivated communities where the drugs are available at a nominal fee through voluntary health workers in the village (*28*). A survey in four CCCD countries, for example, showed that few women had taken weekly chemoprophylaxis during their pregnancy, ranging from 2% in Zaire to 18% in the Central African Republic (Table 3). Second, in areas of chloroquine resistance, officials are becoming increasingly concerned that the recommended weekly dose for chloroquine chemoprophylaxis (5 mg/kg) may not be effective in preventing placental infection. Third, probably because of immunosuppression during pregnancy, chloroquine was less effective against malaria infections in women in their first and second pregnancy compared with the response in non-pregnant women or those in later pregnancies (*29*). Operational research to assess the efficacy of alternative approaches as well as to identify those pregnancies at greatest risk is being carried out in the CCCD countries. Such studies are essential to develop a more rational policy for pregnant women.

HEALTH EDUCATION AND TRAINING

Parents and communities must be involved in the process of disease recognition, therapy, and prevention if the existing patterns of childhood morbidity and mortality are to be improved. Health education implies training individuals in the community and in health units to recognize specific symptom complexes such as fever–malaria and diarrhoea–dehydration, and to apply appropriate therapy. Behaviour alteration is a critical element for effective primary health care and the CCCD project has been promoting among parents and health service staff the importance of prompt and effective treatment.

The strategies for health education should be based on the community's perception of the illness and usual treatment practices. The perceptions may vary, depending on the endemicity of the disease. The treatment and prevention practices will depend upon local economic conditions, the availability of drugs, and knowledge of drug use among the consumers and dispensers of treatment. Schools, women's groups and the media should be included in community education. Proper training, retraining, supervision and an adequate supply of drugs will yield the best results in the health units.

Training in malaria control has been part of a series of primary health care training sessions in each CCCD country. These are held throughout the country and are attended by local public health officials as well as doctors and nurses who provide the treatment and prevention services. Malaria, diarrhoea and vaccine-preventable diseases are covered during the same training period. With CCCD support, over 5000 health workers have been trained in the diagnosis and treatment of malaria and in the management of patients using specially designed self- and group-learning manuals.[j] Educational materials (posters, media messages, and technical notes) have been produced locally and distributed in seven countries at all levels of the health services including the most peripheral dispensaries. An additional 125

[i] WORLD HEALTH ORGANIZATION. *Informal consultation on the diagnosis and management of malaria in the primary health care system in Africa, Brazzaville, Congo, 7–14 December 1987* (unpublished report).

[j] CENTERS FOR DISEASE CONTROL, *Combatting Childhood Communicable Diseases, Delivery of Services: Malaria (Instructor's training course)*, Atlanta, 1985 (International Health Program Office internal document), pp. 20–21.

Table 3. Data on women using antimalarial drugs during pregnancy in four CCCD countries, 1985–86

Country	No. interviewed	Prenatal clinic visit		Took antimalarial drugs	
		No. who attended	Advised to take antimalarials	At least once	Weekly
Central African Republic	136	—	—	75 (55)[a]	24 (18)
Liberia	1785	—	876 (49)	590 (67)	134 (16)
Togo	2998	2458 (82)[a]	2217 (74)	2035 (68)	507 (17)
Zaire	11 648	9897 (85)	—	2709 (23)	148 (2)[b]

[a] Figures in parentheses are percentages.
[b] Question asked to 9857 women only.

persons from the 12 CCCD countries with malaria have been trained in the field in drug-sensitivity testing methodology and operations and, following the training, were provided with materials and other support to continue these activities. Clearly, what is required for most of the education, training, supervision and motivation activities are novel approaches to ensure the programme's success.

PROGRAMME IMPACT

The inclusion of malaria control in primary health care programmes should help to reduce severe illness and death. Although this objective is laudable and long overdue and the proposed interventions appear appropriate, both human and financial resources are limited especially in Africa. Thus, it is imperative that the malaria strategies should be monitored to determine compliance with treatment guidelines and their impact on severe illness and mortality. The CCCD projects are now attempting to assess the changes in both the process indicators (e.g., proportion of children and pregnant women receiving appropriate therapy and chemoprophylaxis, respectively) and the health indicators (e.g., changes in frequency of severe illness and mortality).

Infant and childhood mortality have been estimated recently in some areas of Liberia, Togo and Zaire by CCCD staff.[k] In these countries, the infant mortality rates are between 78 and 215 per 1000 live births, and under-5 mortality between 191 and 365 per 1000 live births, figures that may be useful indicators of the overall effect of the CCCD programme, and of other interventions for national development. These surveys were conducted early in the programme by interviews with women who had been pregnant in the preceding six years; therefore, the causes of death could not be determined. Sentinel hospital surveillance, prospective population-based surveys or other imaginative approaches will be needed to determine the frequency of severe illness and disease-specific mortality.

In 1952, Bruce-Chwatt reported that 12.5 per 1000 children under 1 year and 7 per 1000 children under 5 years of age died from malaria each year in Lagos (*30*). Extrapolating these findings to all of Nigeria, he concluded that 2.4 malaria deaths per 1000 total population occurred annually; one half of the deaths were directly due to malaria, and one half were associated with malaria. The total deaths may have been underestimated because the study was conducted in an urban area having better health care. This study has been the basis of the widely publicized figure of one million malaria-related childhood deaths occurring in Africa each year. This figure must be revised in the light of economic developments in Africa during the past three decades and other influences, e.g., increased availability of drugs and other commodities, improvements in services, education and general information, and other interventions that could have reduced the overall mortality rates. The new estimate of the number of deaths might be the same or even rise, because of the high continuing birth rate and population growth or the presence of CRPF.

The malaria mortality rate in rural Gambia was recently reported to be 6.3 per 1000 per year in infants under 1 year of age, and 10.7 per 1000 per year in children aged 1–4 years (*31*). Almost all these deaths occurred at home, without any treatment from government health units. One must be cautious in extrapolating these results because of the small numbers and the seasonal changes in malaria prevalence, but it can be estimated that in Africa south of the Sahara about 110 000 deaths per year in children under 1 year of age, and about 575 000 deaths in children 1–4 years of age each year are due to malaria—a staggering toll.

[k] CENTERS FOR DISEASE CONTROL. *Combatting childhood communicable diseases, 1985 annual report*. Atlanta, 1986 (International Health Program Office internal document), pp. 18–19.

64

Attribution of the cause of death in Africa has proved to be highly subjective because neither medical care nor post-mortem examination is available for most cases that die; many children die with multiple problems, such as malaria, lower respiratory disease, diarrhoea, and undernutrition. Consequently, the most important and accessible statistic will be the changes in overall mortality.

NATIONAL COMMITMENT

Information from the various surveys and other sources has been used by the CCCD countries to develop their national policies (Table 4). The most difficult issues have been concerned with: definitions of treatment needed for patients with uncomplicated malaria and those with severe illness in the areas with and without CRPF; establishment of a functioning drug-sensitivity monitoring network as part of the public health system; assessment of alternative drugs; development of chemoprophylaxis policies; establishment of criteria for referral of patients who do not respond satisfactorily to initial treatment; and, above all, delivery of prompt and proper treatment to a higher number of febrile children.

Eleven of 12 endemic countries with CCCD projects now have malaria control units and have a written CCCD malaria control plan; only 4 of these units existed when the CCCD project began and all were concerned mainly with vector control issues at that time. These units have been responsible for (1) disseminating information on malaria; (2) training peripheral and intermediate-level health workers in the diagnosis, treatment and prevention of malaria and in the provision of drug-use schedules for clinics and hospitals; and (3) performing operational research directly related to the CCCD strategy development. A dramatic early effect of educating health professionals has been the decrease in unnecessary quinine injections in Togo, from 56% as the first-line treatment for all fever episodes in children in 1983, to 17% in 1985 and 7% in 1987 (A. Gayibor, personal communication, 1988). This followed widespread dissemination in Togo of the results of operational research which showed that a single dose of oral chloroquine was very effective in eliminating parasitaemia and clinical illness (*11*).

CONCLUSION

Many constructive steps can be take to control malaria in Africa if planners take into account the considerable variation that exists in the intensity of transmission, the risk of disease, and the resources available for control efforts. Malariologists in endemic countries should look at these issues individually when planning the interventions. Primary health care initiatives, like the CCCD project's support to African governments, represent a constructive begin-

Table 4. Status of malaria control activities in 12 CCCD countries (total population, 166.2 million) in 1987

		Ministry commitment		
		Malaria coordinating unit		
Country[a]	Population (millions)	In the year when CCCD began	In 1987	Written CCCD malaria policy, 1987
Zaire (1982)[b]	31.3	No	Yes	Yes
Togo (1983)	3.0	Yes	Yes	Yes
Liberia (1983)	2.3	No	Yes	Yes
Malawi (1984)	7.3	No	Yes	Yes
Swaziland (1984)	0.7	Yes	Yes	Yes
Congo (1984)	1.8	No	Yes	Yes
Central African Republic (1984)	2.7	No	Yes	Yes
Rwanda (1984)	6.5	No	Yes	Yes
Guinea (1985)	6.2	Yes	Yes	Yes
Côte d'Ivoire (1985)	10.5	No	Yes	Yes
Burundi (1985)	4.9	No	No	Yes
Nigeria (1986)	89.0	Yes	Yes	No

[a] Lesotho has no endemic malaria.
[b] Year when the CCCD programme began is given in parentheses.

ning to develop locally appropriate strategies that can be sustained by national and community resources.

A strategy to ensure prompt recognition of probable malaria infections followed by effective treatment is the first step towards the control of malaria. Drug therapy may decrease the risk of severe infection, but will not, by itself, alter transmission in the community. The health care system, linked to effective community mobilization, is essential for these immediate drug distribution initiatives to succeed. The infrastructures developed in these programmes represent the nucleus around which more comprehensive malaria control efforts can develop (*32*). These activities can also provide the stimulus for development of a more comprehensive health care delivery system.

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RÉSUMÉ

LUTTE CONTRE LES FORMES GRAVES DU PALUDISME CHEZ L'ENFANT EN AFRIQUE

Une initiative baptisée « Initiative pour la survie de l'enfant africain—lutte contre les maladies transmissibles de l'enfance » (en anglais: Africa Child Survival Initiative—Combatting Childhood Communicable Diseases (CCCD)) a été lancée en 1982 en vue de réduire la mortalité infantile due au paludisme, à la diarrhée et aux maladies évitables par la vaccination. Elle couvre maintenant 13 pays africains dont 12 où le paludisme est endémique. La stratégie adoptée pour la lutte contre le paludisme est fondée sur l'utilisation de médicaments, principalement la chloroquine, visant à éviter les manifestations graves ou mortelles chez les enfants de moins de 5 ans; la chimioprophylaxie est également préconisée pour les femmes enceintes, afin de prévenir l'insuffisance pondérale à la naissance. Cette stratégie s'inspire des recommandations formulées par l'OMS à l'intention des pays aux ressources limitées, après qu'elle eut cessé de mettre l'accent sur l'éradication du paludisme au profit de la lutte contre cette maladie.

Les activités du CCCD en matière de lutte contre le paludisme visent à aider les pays à recueillir des informations, à élaborer des stratégies nationales et à les mettre en œuvre. Depuis 1982, 9 des 13 pays ont étudié la sensibilité de *Plasmodium falciparum* à la chloroquine chez l'enfant et ont établi un réseau de surveillance de la chimiosensibilité. Même dans les régions où *P. falciparum* est chloroquinorésistant, on a constaté que le traitement à la chloroquine faisait baisser la température des enfants fiévreux et amenait une réduction importante de la densité des parasites, empêchant ainsi l'apparition de formes graves et éventuellement mortelles de la maladie. Les enquêtes effectuées dans 6 pays ont mis en évidence une grande variation dans les modalités du traitement; c'est ainsi que la chloroquine est utilisée à des doses variables par les familles et que les centres de soins font un usage excessif des injections de quinine. Etant donné que, bien souvent, les femmes enceintes ne suivent pas de traitement chimioprophylactique, des recherches ont été entreprises pour trouver d'autres solution, afin d'éviter les effets néfastes du paludisme sur le fœtus.

Sur les 12 pays impaludés, 4 seulement avaient des centres de lutte contre le paludisme lorsque le programme CCCD a débuté; 11 de ces pays possèdent maintenant de tels centres et ont établi un programme écrit de lutte contre le paludisme conforme à la stratégie du CCCD. Des équipes nationales de lutte contre le paludisme ont été chargées de la recherche opérationnelle et de la formation de milliers d'agents de santé en ce qui concerne le traitement et la prévention du paludisme ainsi que l'évaluation de la chimiosensibilité. L'expérience acquise et l'infrastructure mise en place dans le cadre des projets CCCD offrent un moyen pratique d'évaluer les stratégies de soins de santé primaires visant à réduire la mortalité infantile en Afrique.

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