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Additional copies are available in English (099-4050) and French (099-4051) from:
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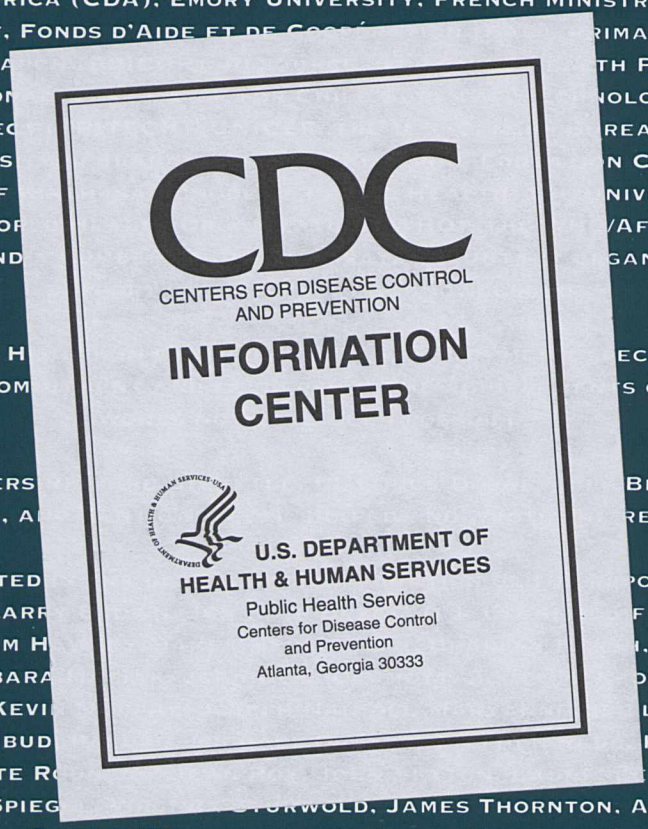

Controlling Malaria in Africa: Progress and Priorities

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
Africa Regional Project (698-0421)
Participating Agency Service Agreement (PASA) No. 0421 PHC 2233

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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ABBREVIATIONS

ACSI	Africa Child Survival Initiative
A.I.D.	Agency for International Development
AQ	Amodiaquine
ARHEC	African Regional Health Education Center (Nigeria)
ARI	Acute respiratory infection
CAR	Central African Republic
CCCD	Combatting Childhood Communicable Diseases
CDC	Centers for Disease Control and Prevention
CFR	Case-fatality rate
CRPF	Chloroquine-resistant *Plasmodium falciparum*
CQ	Chloroquine
DHS	Demographic and Health Survey
EC	European Community
FAC	Fonds d'Aide et de Coopération
HIS	Health information systems
HIV	Human immunodeficiency virus
IDRC	International Development Research Center (Canadian Technical Assistance)
KAP	Knowledge, attitudes, and practices
LBW	Low birth weight
LGA	Local government area
MMRP	Mangochi Malaria Research Project
MOH	Ministry of Health
MQ	Mefloquine
MUHS	Mortality and Use of Health Services
ODA	Overseas Development Agency (British Technical Assistance)
PHC	Primary health care
SP	Sulfadoxine-pyrimethamine
TBA	Traditional birth attendant
UNICEF	United Nations Children's Fund
WHO	World Health Organization

EXECUTIVE SUMMARY

The malaria component of the Africa Child Survival Initiative-Combatting Childhood Communicable Diseases (ACSI-CCCD) Project (1981-1993) added greatly to the understanding of the impact of malaria on the health and survival of African children and clarified and promoted the strategies necessary to control malaria in sub-Saharan Africa. The malaria effort documented ways in which the malaria parasite contributes to morbidity and mortality of young children: acute malaria illness, chronic or persistent parasitemia with anemia, and perinatal malaria infection in the mother, which can cause low birth weight and early infant mortality. The project's malaria activities helped determine the efficacy of control measures and assisted programs with training, health education, and monitoring and evaluation–support strategies necessary to limit the impact of malaria in African countries south of the Sahara.

At the outset of the project, knowledge of the epidemiology and control of malaria in Africa was incomplete, the small number of existing malaria programs were largely ineffective, and few international donor organizations supported malaria programs in this region. International attention has now been drawn to the seriousness of the malaria problem, and a network of donors has been established. Most important, however, is that the capacity of African nations to control the disease that is responsible for the deaths of more than 1.5 million children in Africa each year has been strengthened through renewed leadership, refined policies, and improved systems for program implementation.

Each of the 12 ACSI-CCCD countries with endemic malaria developed malaria-related activities. Although countries participated in these activities to varying degrees, most nations were involved in efforts in these areas: leadership and policy development, operational research (including studies designed to improve implementation of malaria programs and to monitor the spread of resistance to antimalarial drugs), and support strategy development.

Information from the project's malaria activities has been shared widely in meetings, and many scientific articles on various aspects of malaria epidemiology and control (based on the work done in the project) have been published. The ACSI-CCCD experiences have greatly influenced the approach to malaria control in many other African countries and in the World Health Organization, particularly in the African regional headquarters.

The accomplishments of the malaria component of ACSI-CCCD provide a firm scientific basis for the challenge ahead in the 1990s: to implement malaria control programs that will improve child survival in Africa.

INTRODUCTION TO THE REPORT

This report is written for the United States Agency for International Development (A.I.D.) and for others who have responsibility for planning, implementing, evaluating, and managing international public health programs. The report summarizes what we at the Centers for Disease Control and Prevention (CDC) have learned from our 12-year involvement in the malaria component of the Africa Child Survival Initiative-Combatting Childhood Communicable Diseases (ACSI-CCCD) Project. Our work and that of our many partners have provided the foundation for developing effective malaria control strategies and for successfully implementing them in sub-Saharan Africa in the 1990s.

Part One provides a history of malaria within the project, reviews the major malaria-related accomplishments, examines the lessons learned, and outlines priorities for malaria control for the next decade.

Part Two summarizes important malaria-related activities in the individual African countries that participated in ACSI-CCCD.

The **Lists of Publications** contain articles written about malaria projects funded by A.I.D. as well as articles about work linked to ACSI-CCCD activities but not directly funded by A.I.D.

In addition, the ACSI-CCCD work on malaria in sub-Saharan Africa is the basis of two other documents. *Addressing the Challenges of Malaria Control in Africa* provides detailed recommendations for controlling malaria through case management and prevention and for implementing malaria control programs. *Malaria prevention in pregnancy: the effects of treatment and chemoprophylaxis on placental malaria infection, low birth weight, and fetal, infant, and child survival* presents the results of a major study conducted in Mangochi, Malawi, from 1987-1990. These three documents are available from:

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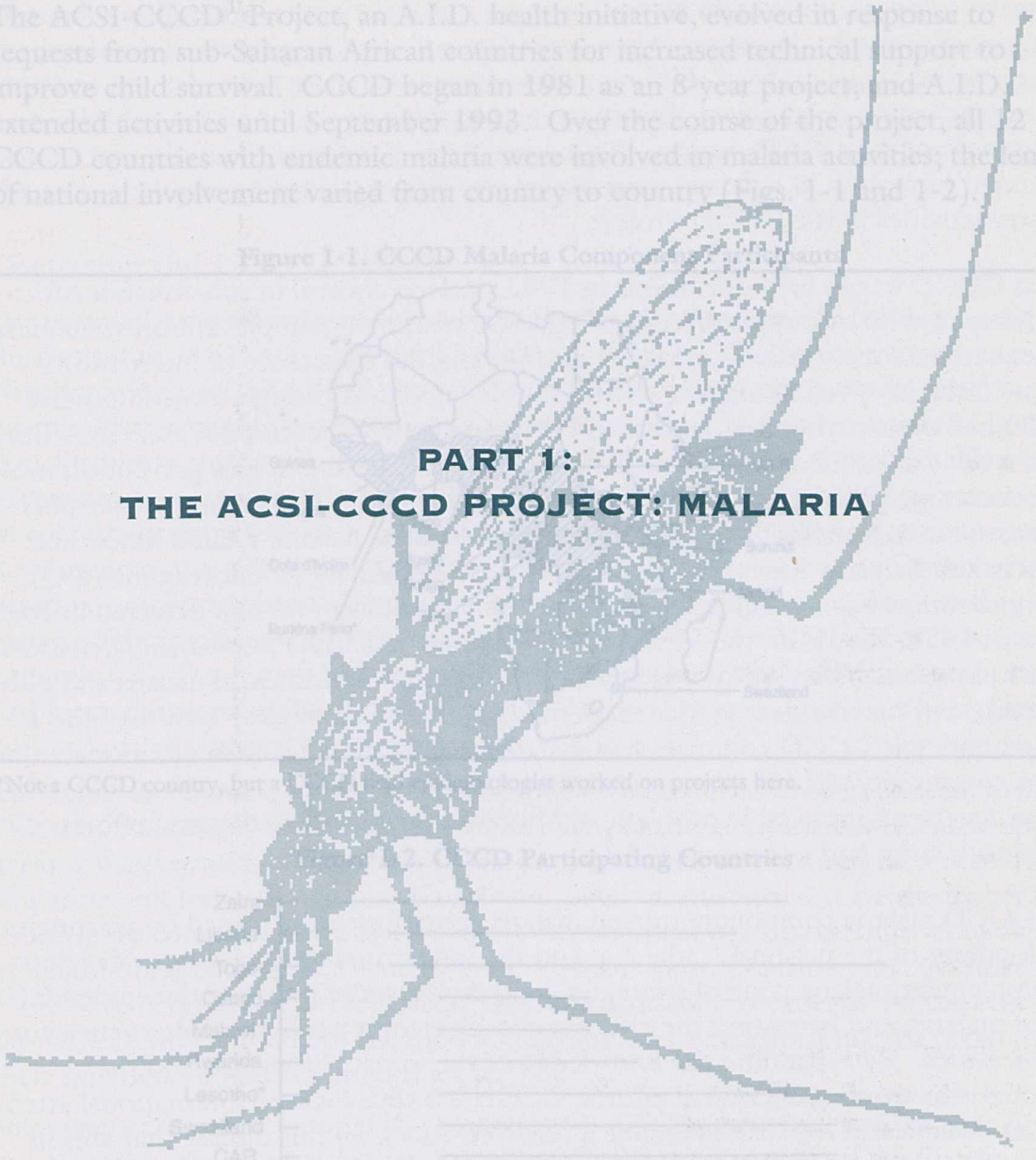
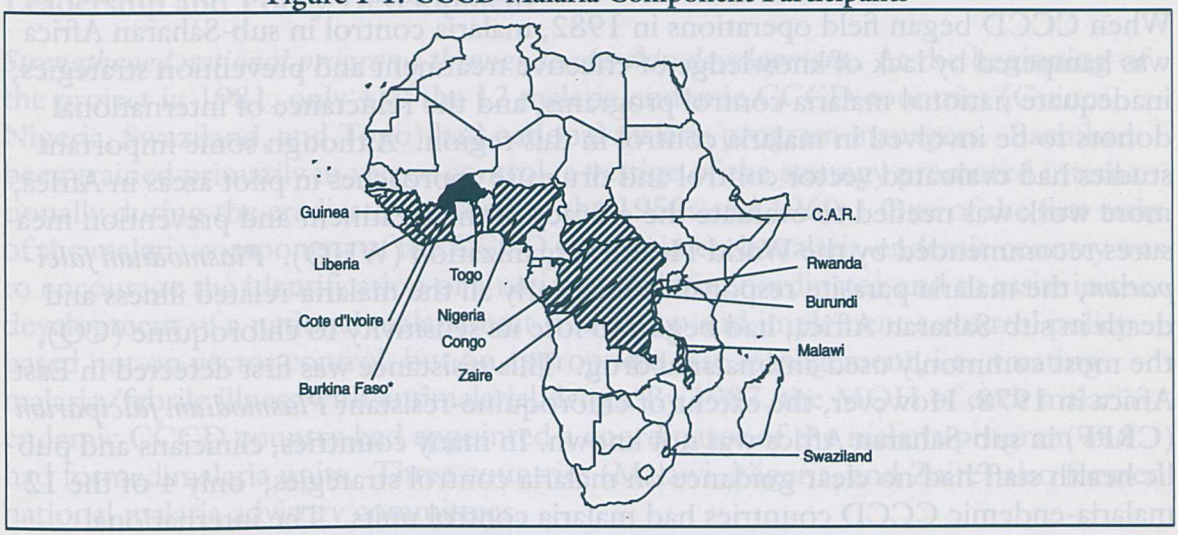


PART 1:
THE ACSI-CCCD PROJECT: MALARIA

SECTION I
BRIEF HISTORY

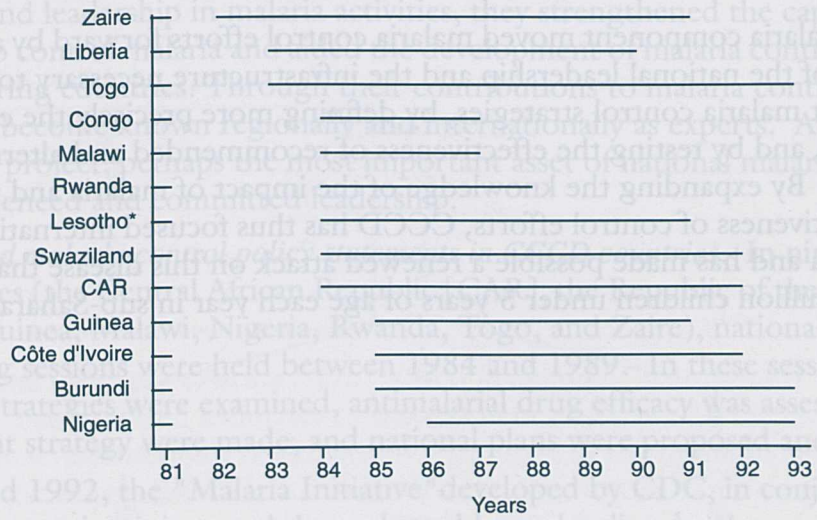
The ACSI-CCCD[1] Project, an A.I.D. health initiative, evolved in response to requests from sub-Saharan African countries for increased technical support to improve child survival. CCCD began in 1981 as an 8-year project, and A.I.D. extended activities until September 1993. Over the course of the project, all 12 CCCD countries with endemic malaria were involved in malaria activities; the length of national involvement varied from country to country (Figs. 1-1 and 1-2).

Figure 1-1. CCCD Malaria Component Participants



*Not a CCCD country, but a CCCD field epidemiologist worked on projects here.

Figure 1-2. CCCD Participating Countries



*No endemic malaria in Lesotho.

[1]The original name of the project was CCCD; ACSI was added in 1988. ACSI-CCCD will be abbreviated as CCCD throughout this document.

The original program design of CCCD in 1981 focused on targeting interventions in two areas: vaccine-preventable diseases and diarrheal diseases. Discussions with Ministry of Health (MOH) officials in Africa revealed their strong interest in including malaria as part of the child survival agenda, and malaria was included as a focus of operational research. However, when early data collected by countries identified malaria as the major cause of child mortality, control measures were defined and consensus reached on appropriate control strategies. Malaria then became a third major component of the CCCD project. While intervention activities focused on prompt treatment of malaria in children, operational research remained a central element of malaria activities in the CCCD Project.

When CCCD began field operations in 1982, malaria control in sub-Saharan Africa was hampered by lack of knowledge of effective treatment and prevention strategies, inadequate national malaria control programs, and the reluctance of international donors to be involved in malaria control in this region. Although some important studies had evaluated vector control and drug use approaches in pilot areas in Africa, more work was needed to evaluate the efficacy of the treatment and prevention measures recommended by the World Health Organization (WHO). *Plasmodium falciparum*, the malaria parasite responsible for nearly all the malaria-related illness and death in sub-Saharan Africa, had begun to lose its sensitivity to chloroquine (CQ), the most commonly used antimalarial drug. This resistance was first detected in East Africa in 1978. However, the extent of chloroquine-resistant *Plasmodium falciparum* (CRPF) in sub-Saharan Africa was not known. In many countries, clinicians and public health staff had no clear guidance on malaria control strategies; only 4 of the 12 malaria-endemic CCCD countries had malaria control units. The international donor community did not support malaria control in Africa because the disease was believed to be an intractable problem and because the global eradication efforts of previous decades had not succeeded.[2]

The CCCD malaria component moved malaria control efforts forward by assisting in development of the national leadership and the infrastructure necessary to develop and implement malaria control strategies, by defining more precisely the epidemiology of malaria, and by testing the effectiveness of recommended and alternative control measures. By expanding the knowledge of the impact of malaria and the potential effectiveness of control efforts, CCCD has thus focused international attention on malaria and has made possible a renewed attack on this disease that kills in excess of 1.5 million children under 5 years of age each year in sub-Saharan Africa.

[2] The WHO Global Malaria Eradication Programme was conducted in the 1950s and 1960s. Despite marked improvement in malaria control in some countries, the program did not achieve its objective and was considered a failure in many places. Program efforts in Africa (except Ethiopia) were limited to a few pilot projects.

SECTION II
ACCOMPLISHMENTS OF THE MALARIA COMPONENT OF CCCD

The accomplishments of the malaria component of CCCD can be seen in four areas: strengthened leadership and policies of national malaria programs, expanded recognition of the impact of malaria infection and disease on children, increased technical understanding of malaria control measures, and improved support components required for control (surveillance and health information systems, training and supervision, health education, and logistics).

Leadership and Policy Development

Strengthened national programs through leadership development. At the beginning of the project in 1981, only 4 of the 12 malaria-endemic CCCD countries (Guinea, Nigeria, Swaziland, and Togo) had national malaria program managers. Each had been trained primarily in vector control, a vestige of the strategy promoted internationally during the eradication efforts of the 1950s and 1960s. One of the first tasks of the malaria component of the CCCD project in each malaria-endemic country was to encourage the identification of a national malaria coordinator and to assist in the development of a national malaria unit to develop and implement a control policy based not on vector control, but on appropriate case management, i.e., treating malaria/febrile illness with antimalarial drugs. By 1987, the MOH of each malaria-endemic CCCD country had appointed a coordinator of the malaria program and had formed malaria units. Three countries (Malawi, Nigeria, and Zaire) also formed national malaria advisory committees.

The achievements of CCCD in malaria control would not have been possible without the competence and extraordinary commitment of these malaria coordinators, program managers, and MOH officials who supported them. Through their active participation and leadership in malaria activities, they strengthened the capacity of their countries to control malaria and aided the development of malaria control capabilities of neighboring countries. Through their contributions to malaria control efforts, many have become known regionally and internationally as experts. At the end of the CCCD project, perhaps the most important asset of national malaria programs is their experienced and committed leadership.

Strengthened malaria control policy statements in CCCD countries. In nine participating countries (the Central African Republic [CAR], the Republic of the Congo, Côte d'Ivoire, Guinea, Malawi, Nigeria, Rwanda, Togo, and Zaire), national workshops and training sessions were held between 1984 and 1989. In these sessions, national treatment strategies were examined, antimalarial drug efficacy was assessed, revisions in treatment strategy were made, and national plans were proposed and developed.

In 1991 and 1992, the "Malaria Initiative" developed by CDC, in conjunction with WHO, sponsored training workshops that addressed policy development (1991) and planning and programming (1992) for malaria control in Africa. Using a structured interactive approach that emphasized current issues, shared experiences, and deci-

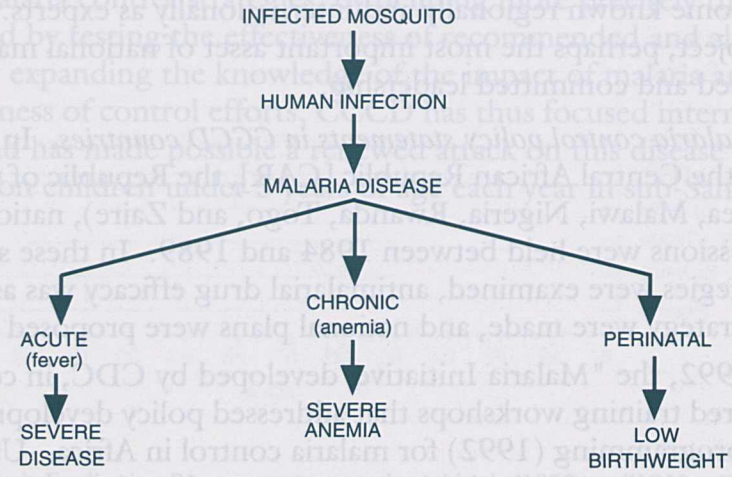
sion-making by participants, the workshops enabled country representatives to draft nationally tailored malaria control policies and plans. These workshops promoted collaboration among the African malaria program managers and were instrumental in improving malaria policies, plans, and programs in 21 French-speaking countries in Africa, including all eight francophone participants in CCCD (Burundi, CAR, the Republic of the Congo, Côte d'Ivoire, Guinea, Rwanda, Togo, and Zaire).

Impact of Malaria Infection and Disease

The research conducted as part of the malaria component of CCCD was instrumental in expanding the knowledge of the health impact of malaria infection and disease in Africa. First, early reviews of data collected from routine health information systems examined the morbidity and mortality due to malaria, focusing on the effect on various age groups and on the severity of illness. In Malawi, Swaziland, Togo, and Zaire, special investigations were undertaken, mainly at health facilities. Surveillance for drug resistance was established to measure the efficacy of treatment with antimalarial drugs. In several countries, operational research studies documented the increase in CRPF and a concurrent increase in malaria-associated morbidity and mortality. Additionally, a large 3-year project designed to examine the effect of malaria in pregnant women and the benefits of antimalarial treatment and chemoprophylaxis, the Mangochi Malaria Research Project (MMRP), was conducted in Malawi. This research provided a tremendous amount of new knowledge about malaria and its impact on African children.

Malaria infection and disease can affect children in three ways (Fig. 1-3): as an acute disease (febrile illness), as a chronic condition (malaria-associated anemia), and as a perinatal condition (placental malaria infection in a pregnant woman leading to low birth weight [LBW][3] in the newborn). Each of these conditions increases a child's risk of dying, either as a direct result of malaria disease or one of its complications, anemia or LBW.

Figure 1-3. Impact of Malaria in Africa

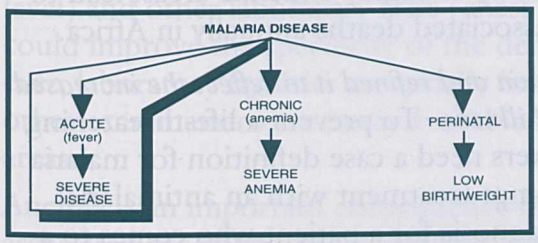


[3] A baby born weighing less than 2500 grams is considered to be low birth weight.

- **Acute febrile illness,** without symptoms or signs of other illnesses, is the operational definition of malaria in a malarious area. If untreated or ineffectively treated, this illness may progress to a severe disease with delirium, seizures, and coma leading rapidly to death.
- **Repeated and chronic malaria infections**, caused by frequent exposure to malaria infection or to ineffectively or incompletely treated malaria episodes, lead to progressive destruction of red blood cells, eventually recognized as anemia. As the consequences of chronic parasitemia intensify, the child becomes more susceptible to other illnesses, such as pneumonia, which might not be fatal in a nonanemic, healthy child. The child is also at risk of death from severe anemia.
- **Perinatal malaria infection**, caused by malaria infection in the mother during pregnancy, causes LBW, which is a major determinant of infant mortality.

CCCD helped refine the understanding of each of the three categories of malaria infection and disease. As a result of new information about the effect of the disease, the focus of malaria control shifted from the traditional emphasis on treating acute febrile illness to controlling chronic malaria infection, which is more important for reducing mortality than was previously thought. Whereas a fatal outcome of an acute attack is relatively unusual, occurring in less than 1 in 1000 malaria cases, the majority of malaria mortality is due to a process of repeated and chronic parasitemia that is ineffectively or incompletely treated (Slutsker et al. 1993a). Consequently, the challenge is not only to manage febrile illness but to recognize which children are at risk of severe disease from recurrent or chronic parasitemia so that their disease can be treated early and appropriately. In the area of perinatal infection, CCCD studies have defined the clinical and epidemiologic impact of malaria during pregnancy. In addition, drug efficacy studies have led to the formulation of more simplified and effective strategies for decreasing the effect of parasitemia during pregnancy, even in areas of CQ resistance.

Acute febrile illness



Calculated the incidence of acute febrile illness in children. Community surveys were conducted that provided estimates of the frequency of acute febrile illness, which, in the absence of microscopic confirmation of parasites in the blood, is considered to be malaria. Surveys conducted in five sub-Saharan African countries between 1983 and 1986 showed that between 14% (Guinea) and 34% (Togo) of the children had had a febrile illness in the previous 2 weeks, which translates into rates of 3-9 malaria/febrile illness episodes per child per year (Breman and Campbell 1988).

Calculated and estimated the incidence of malaria-associated death in children. Because in this region many children die at home and not at a health facility (Steketee et al. 1993a), the exact number of childhood deaths caused by malaria is difficult to determine. CCCD studies used various approaches to determine the number of deaths that were caused by malaria or a malaria-associated illness.

One study followed infants in Malawi for 2 years after birth. Malaria and malaria-associated anemia accounted for 18.7% of infant deaths (malaria-specific infant mortality rate = 30/1000). For children surviving their first year, malaria and malaria-associated anemia accounted for 25.6% of deaths (malaria-specific second year mortality rate = 34/1000). Most of the infant (65%) and second-year (62%) deaths occurred at home (Steketee et al. 1993a).

At Mama Yemo Hospital in Zaire, pediatric and mortuary records for 1 year were examined to determine the effect of malaria on hospitalized children (Greenberg et al. 1989a). Children under 14 years of age who were diagnosed with malaria on the basis of clinical and parasitologic data had a 21.1% inpatient case-fatality rate (CFR).[4]

Another study attempted to establish reasonable estimates of CFRs using the Delphi survey technique (Sudre, Breman, and Koplan 1990). In a Delphi survey, respondents are repeatedly asked the same questions; each time they are questioned, they are given other respondents' answers and asked to respond again to obtain a consensus. Nineteen medical experts, all with extensive experience treating malaria in African children, were surveyed to learn what they judged to be likely CFRs for acutely febrile children contracting malaria in areas of differing resistance.[5] Estimated CFRs for acute malaria illness ranged from .045% in areas of low and moderate resistance to 5% in areas of high resistance.

When these studies are examined in the context of supporting information from other sites (The Gambia, Kenya, Nigeria), several aspects of malaria stand out. Acute severe disease among hospitalized children has a high CFR, in the range of 20%. But most of the malaria-associated deaths are not seen in facilities, and the summary rates of malaria-associated death (approximately 30 deaths/1000 infants or children), when applied to African populations in moderately to highly endemic areas, lead to an estimate of more than 1.5 million malaria-associated deaths annually in Africa.

Assessed the value of the operational case definition and refined it to reflect the increased knowledge of the impact of malaria infection and illness. To prevent a life-threatening illness caused by malaria infection, health workers need a case definition for malaria illness that will identify children who need prompt treatment with an antimalarial drug. Traditionally, "malaria" has been the diagnosis for a patient who comes to a clinic with a recent history of fever or presence of elevated temperature and no other

[4]The case-fatality rate is the ratio of the number of deaths to the number of cases.

[5] Drug resistance occurs when malaria parasites are no longer eliminated by the drug acting in synergy with the individual's established immune protection against the parasite. The three levels of drug resistance (RI = low, RII = moderate, RIII = high) are based on parasitologic response. RI resistance is characterized by temporary disappearance of the parasite from peripheral blood followed by return >7 days after therapy. RIII resistance is characterized by limited (<75% of initial density) or no reduction in parasite density in peripheral blood (World Health Organization 1973). Resistance varies by geographic area and by age (acquired immunity may reduce the resistance level in older individuals).

obvious explanation for the fever (pneumonia, measles, otitis media, etc). However, such a clinical definition presents several problems. First, CCCD studies in Malawi and Zaire and other studies in Burkina Faso (Baudon et al. 1988) and in Niger (Olivar et al. 1991) have shown that history of fever can be a poor predictor of malaria parasitemia; consequently, much overtreatment occurs, and children with fever caused by another illness may not be properly treated. Another more serious problem is that fever does not characterize malaria-associated anemia, which is caused by repeated or chronic malaria parasitemia.

CCCD studies were conducted to determine ways to make the clinical definition identify more accurately those patients with malaria illness (a more "specific" definition). For example, children admitted to a hospital emergency ward in Kinshasa, Zaire, with an axillary temperature of at least 37.5°C (comparable to an oral temperature of 38°C or a rectal temperature of 38.5°C) were more likely to be parasitemic than children with lower temperatures (Hedberg et al. 1989). In Malawi, parasitemia was associated with an axillary temperature $\geq$37.3°C, history of fever within the preceding 48 hours, reduced appetite, and reduced fluid intake (Pappaioanou et al. 1991). A few studies defined parasite density cutoffs (>2000/mm^3; >5000/mm^3; or >10,000/mm^3 of blood) above which malaria infection was more likely to be the cause of the fever (Trape, Peelman, and Morault-Peelman 1985) and correlated directly the levels of parasitemia and increased temperature (Delfini 1968). Others examined the predictive value of fever and found that fever is a better predictor of parasitemia during high transmission season than during low malaria transmission season (Olivar et al. 1991; Rougemont et al. 1991). These studies demonstrated that the addition of specific signs and symptoms can increase the specificity of the diagnosis for malaria.

Greater specificity, however, can result in reduced sensitivity. In other words, a case definition encompassing these additional signs and symptoms would identify a lower proportion of patients with malaria illness. The challenge therefore is to make the case definition more specific without compromising its sensitivity. By ascertaining or excluding other causes of fever, both microscopy (to determine parasite presence and level) and other laboratory tests (chest radiograph, blood culture, lumbar puncture) could improve the specificity of the definition without changing its sensitivity. However, laboratory facilities are usually limited and expensive; hence, microscopy and other examinations are rarely available in health facilities in Africa, especially in rural areas.

Anemia is an important consequence of malaria and a major contributor to malaria-associated mortality. Since children may become anemic because of malaria without being febrile, criteria are needed to identify children with malaria-associated anemia. A broader case definition to establish which children need antimalarial treatment therefore requires both an assessment of fever and a systematic evaluation for anemia. Although laboratory determination of hematologic status would identify anemic children, few peripheral health facilities in Africa can routinely perform hemoglobin or hematocrit evaluations. Clinical signs, e.g., palmar crease, nailbed, or tongue pallor, can be used to recognize anemic children. Epidemiologic criteria, such as defined age groups of children most likely to become anemic, can be useful in identifying

anemic children in need of treatment. One CCCD study in Malawi showed that in an area of high malaria transmission, malaria-associated anemia was common, but limited mostly to children between 6 and 24 months of age; in this area, all children in this age group presenting with fever should receive treatment with a highly effective antimalarial to clear parasitemia and prevent malaria-associated anemia.

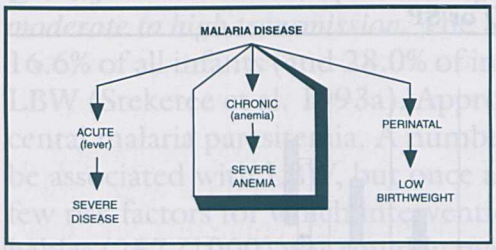
The overriding goal of malaria case management is to treat children promptly with an effective antimalarial if they are at risk of developing a life-threatening illness due to malaria infection. Therefore, clinicians and public health specialists need a sensitive case definition, even though its use will cause some aparasitemic children to receive an antimalarial drug. Consequently, although CCCD studies have provided ways to refine the clinical case definition of malaria, *"fever or a history of fever within the previous 48 hours without symptoms of another illness"* should continue to be used in a setting of endemic malaria transmission in Africa. Where trained workers can provide microscopic diagnosis, the case definition may be expanded to include *"fever or history of fever within the previous 48 hours and parasitemia of any density."* Although further work is required to determine necessary treatment for anemic and severely anemic children, serious consideration should be given to treating these children with antimalarial drugs.

Assessed the economic burden of malaria to the people and the nation of Malawi. In addition to the suffering from illness and death that malaria causes, this disease exacts a heavy economic toll on both the families and the nations of sub-Saharan Africa. A study conducted in Malawi found that the average family spends 5% of its income on treating and preventing malaria illness (Ettling and McFarland 1993). Very low income households (those earning less than $150 per year) spend a much greater proportion of their income, 23.3%, on malaria treatment and prevention measures. In addition, indirect costs to households, measured in lost productivity caused by adult illness or by the time adults spend caring for sick children, are 3.5% of household income. In sum, total annual costs of malaria, both direct and indirect, range from 8.5% of the annual average income for all households to 26.8% of the income for very poor households.

At the level of the health system, the cost of malaria is also high. Direct costs are estimated at $1.03 million for outpatient treatment in health facilities and $1.08 million for inpatient treatment. These costs represent 10.1% of the annual expenditures of the MOH. Estimates of costs attributable to premature malaria mortality and morbidity range from $31.7 million to $83.9 million. With a gross domestic product of $1.7 billion in 1991, such losses represent a substantial economic burden to Malawi (Ettling and McFarland 1993).

Although few studies of the economic impact of malaria have been conducted, the situation in Malawi is likely representative of other malaria-endemic countries in sub-Saharan Africa. Beyond the burden of morbidity and mortality of malaria lies its enormous impact on individual and household productivity and national development.

Chronic malaria infection and the development of anemia

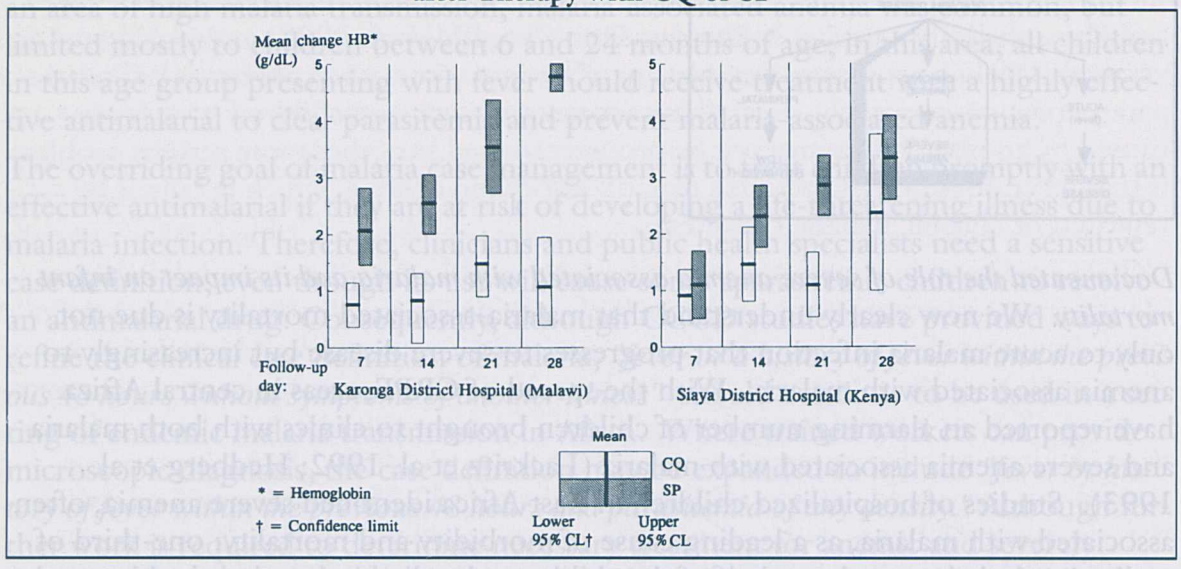


Documented the role of severe anemia associated with malaria and its impact on infant mortality. We now clearly understand that malaria-associated mortality is due not only to acute malaria infection that progresses to severe disease but increasingly to anemia associated with malaria. With the spread of CRPF, areas in central Africa have reported an alarming number of children brought to clinics with both malaria and severe anemia associated with malaria (Lackritz et al. 1992; Hedberg et al. 1993). Studies of hospitalized children in East Africa identified severe anemia, often associated with malaria, as a leading cause of morbidity and mortality: one-third of pediatric admissions and one-half of the children who died in hospitals had hemoglobins below 5.0 g/dL (Lackritz et al. 1992). Furthermore, blood transfusions to treat severe anemia carry the additional risk of human immunodeficiency virus (HIV) infection (Greenberg et al. 1988). More judicious use of blood transfusions is therefore warranted (Lackritz et al. 1992).

Documented the importance of hematologic recovery[6] *in treating malaria and tested efficacy of alternative antimalarial drugs to achieve recovery.* Studies of malaria and anemia in children in Kenya (a non-CCCD country) and Malawi (CCCD-supported) have demonstrated the importance of using a drug that will rapidly clear parasitemia to allow hematologic recovery (Bloland et al. 1993). Of the children with both malaria and anemia (≤8 g/dL) in settings where CQ had not been effective in clearing parasitemia, those who received sulfadoxine-pyrimethamine (SP) improved significantly more than those who received CQ (Fig. 1-4). Thus, treatment of parasitemic children with an effective antimalarial drug that clears the parasitemia is critically important to allow these children to return to normal hematologic status.

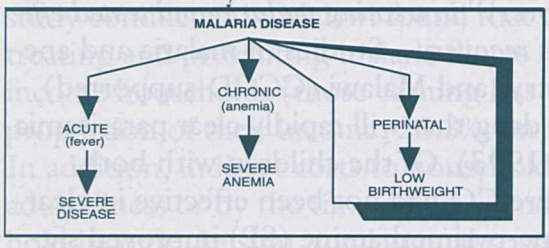
[6] Hematologic recovery is defined as the return to the preillness level of hemoglobin concentration.

Figure 1-4. Change in Hemoglobin Concentration in Anemic Children after Therapy with CQ or SP



Courtesy of Peter Bloland, Malaria Branch, CDC.

Perinatal infection: malaria in pregnancy and its effect on birth weight and infant mortality



Determined which pregnancies were at greatest risk for the adverse effects of malaria infection. CCCD studies in Burkina Faso, Malawi, and Zaire confirmed that pregnant women in their first or second pregnancies had higher frequencies of parasitemia, higher parasite densities, and higher rates of LBW babies than those in later pregnancies (Steketee et al. 1988a; Cot et al. 1992; Steketee et al. 1993a). The studies highlighted the importance of focusing malaria prevention efforts on these pregnant women.

Found that symptoms of malaria do not always accompany the presence of parasites in the bloodstream or in the placenta of pregnant women. In Malawi, results of a study of the effectiveness of chemoprophylaxis among pregnant women revealed that none of the pregnant women who were parasitemic at enrollment in the study and just over 1 in 10 who developed parasitemia while taking CQ prophylaxis had either fever or other signs and symptoms of malaria. Thus, a prevention strategy based on treating only symptomatic pregnant women, as suggested by some health officials, would not prevent the majority of malaria infections in pregnant women (Steketee et al. 1988a).

Quantified the relationship between placental malaria infection and LBW in an area of moderate to high transmission. The Mangochi Malaria Research Project found that 16.6% of all infants (and 28.0% of infants born to primigravidas) born in this area had LBW (Steketee et al. 1993a). Approximately 10% of LBW could be attributed to placental malaria parasitemia. A number of maternal characteristics were also found to be associated with LBW, but once a woman becomes pregnant, malaria is one of the few risk factors for which intervention is possible. The infant mortality rate for LBW babies (257/1000) was roughly twice that of babies of normal weight (128/1000). Although other risk factors were associated with neonatal and infant mortality, LBW was found to be a major determinant of this mortality.

Demonstrated that an effective antimalarial drug can be used in pregnant women to reduce the frequency of LBW. The MMRP demonstrated that mefloquine (MQ), used as initial treatment followed by weekly prophylaxis, reduced the frequency of breakthrough infections (development of parasitemia while taking a drug, following clearance of parasitemia), placental malaria, and LBW and that the greatest reduction in the number of LBW babies could be achieved for babies born to women in their first or second pregnancies (Steketee et al. 1993a).

Relationships between malaria and other diseases

As knowledge of the full impact of malaria infection and disease improved, so did awareness of the connections between fever and parasitemia, and between fever and other potentially life-threatening diseases or conditions, such as pneumonia, bacteremia, diarrheal disease, hypoglycemia, and HIV.

Determined that in children current clinical case definitions for malaria and pneumonia[7] *do not differentiate between the two diseases.* Pneumonia is one of the major causes of morbidity and mortality in African children, especially in infants. A study conducted in Malawi showed that children with clinical evidence of pneumonia almost always have fever, the chief sign and symptom of a malaria infection (Redd et al. 1992). It is not clear, however, whether malaria increases a child's risk of pneumonia or whether the diseases simply share a common clinical presentation.

Identified a drug effective in treating both malaria and pneumonia. In a CCCD study in Malawi, the efficacy of cotrimoxazole, one of the three first-line drugs for the treatment of pneumonia, was evaluated for its success in treating falciparum parasitemia in children less than 5 years of age (Bloland et al. 1991). Despite a regimen that could easily result in poor compliance–two doses daily for 5 days–cotrimoxazole was found to be an effective treatment for children who have both malaria and pneumonia.

Observed a clinical overlap in disease manifestations. A study of diarrheal disease among children in Côte d'Ivoire found that many children with diarrhea had both bacteremia and malaria infections. Although children with bacteremia or malaria may

[7] The case definition for malaria when microscopy is unavailable is the presence or history of fever without other obvious cause (WHO 1986). The case definition for pneumonia is presence or history of cough, accompanied by an increase in respiratory rate.

show symptoms of febrile illness, each disease requires a different treatment and must be diagnosed properly. In this 1991 study, bacteremia could be distinguished from malaria only by laboratory examination, which is not available in most health facilities (Lee et al. 1992).

Examined the role of multiple infections in sick children. The previously mentioned study of children from Côte d'Ivoire also found that severely ill children were more likely to have signs of dehydration, bacteremia, parasitemia, severe anemia, and malnutrition than those less severely ill (Lee et al. 1992).

In a 1988 study of hospitalized children in Zaire, common causes of fever were malaria parasitemia and bacteremia, which were not possible to differentiate without the use of microscopy and blood culture (Hedberg et al. 1989). Bacteremia was present in 16% of severely ill children, and although it was an important cause of fever, bacteremia was not commonly associated with parasitemia.

Found that hypoglycemia was associated with both malaria illness and death and with therapy using quinine. Work with Gambian children (White et al. 1987) indicated that hypoglycemia is a manifestation of severe malaria and is caused by glucose consumption by the parasite. In addition, in this study, children with severe malaria and hypoglycemia were more likely to die than those with only severe malaria. Hypoglycemia was also associated with therapy using quinine, the recommended drug for severe malaria. Whether or not hypoglycemia contributes to death or whether it simply reflects a severe, often fatal, infection is not clear. Regardless, treatment of parasitemia with quinine and the assessment and treatment of hypoglycemia with glucose in severely ill children is warranted.

Identified HIV as a risk factor for malaria in pregnancy. Recent work in Malawi showed that HIV-positive pregnant women were more likely than HIV-negative women to have a higher prevalence and density of placental malaria infection, which in turn is associated with LBW (Steketee et al. 1993b).

Malaria Control Measures

One of the important contributions of the malaria component of CCCD was the evaluation of the effectiveness[8] of control measures. These studies addressed two important issues:

- Determining drug regimen and drug efficacy[9] among children and pregnant women
- Monitoring the progression of CRPF and providing data needed to revise national malaria policies through the establishment of national drug-testing surveillance systems

[8] Effectiveness can be defined as the improvement in health outcome that a treatment or prevention strategy can produce in typical community-based settings.

[9] Efficacy can be defined as the improvement in health outcome that a treatment or prevention strategy can produce in expert hands under ideal circumstances.

Developed a standardized protocol for assessing the efficacy of antimalarial drugs. The protocol developed was first used in individual operational research projects and then became a national surveillance method in several countries. The essential feature of this protocol was the modification of the 7-day in vivo test developed by WHO for use in evaluating malaria parasite response to antimalarial drugs (Table 1-1). In the WHO scheme, infected persons were followed daily for 7 days after therapy and weekly thereafter for 3 weeks (Bruce-Chwatt 1986). The modified version developed by the CCCD project examined a younger group of children (less than 5 years of age) to reflect the actual at-risk population in most of sub-Saharan Africa and required a follow-up only on days 2, possibly 3, and 7. Temperatures of children were assessed to determine clinical response to therapy. The follow-up was later extended to 14 days to detect recrudescences (Ekanem et al. 1990) and to 28 days to monitor hemoglobin concentrations (Bloland et al. 1993).

An additional modification to the WHO in vivo test included a reduction in the sample size. A sampling scheme dictated by sequential analysis (Lemeshow and Stroh 1988) was used to allow for quick decisions and for fewer participants in drug efficacy studies. This was done by calculating the effect on total efficacy rate of the success or failure of the drug in each group of individuals and then determining if more children needed to be included in the testing. This sampling system was used to ascertain whether the drug success rate was at least 99% or the failure rate was at least 10%, the cutoffs considered adequate for formulating national policy (Khoromana et al. 1986; Breman et al. 1987)

Table 1-1. CCCD Modification of WHO In Vivo Test

	WHO 7-day in vivo test	CCCD-modified test
Ages of participants	6-14 years (usually)	<5 years
Parasite levels	≥800 asexual forms/mm^3 (usually)	≥1000 or 2000 asexual forms/mm^3
Use of drugs	No history of antimalarial drugs for 1 week. Negative Dill-Glazko urine test for 4-aminoquinolines	Negative Dill-Glazko, Haskins, or Saker-Solomons test for 4-aminoquinolines*
Blood smears	Thick and thin blood smears daily from Day 0 to Day 7, weekly to Day 28	Thick and thin blood smears Day 0, Day 2, Day 7, Day 14‡, Day 28‡
Health status of patients	Asymptomatic school children	Preferentially symptomatic. Excluded if too ill to be treated orally. Axillary temperature taken each visit.
Follow-ups	Day 1 through Day 7, weekly to Day 28	Day 2, Day 3†, Day 7, Day 14‡, Day 28‡
Number of patients and analysis	"At least 30 persons" but no definite scheme	Dictated by statistical sampling using a modification of sequential analysis§

*See revision of field urine tests in text.

†Day 3 follow-up for those still parasitemic on Day 2.

‡Days 14 and 28 for assessment of hemoglobin added in later studies.

§Sample size was established to detect greater than 10% resistance or less than 1% resistance with 90% confidence. An initial group of 31 children was tested; the sample size was increased if the estimated prevalence of resistance fell between 1% and 10%.

Developed field tests to evaluate antimalarial drug use in children and pregnant women. Improved field methods to detect CQ and SP in urine (and blood) were developed and field tested. These test methods, which were frequently used to examine home use of antimalarials or patient compliance with chemoprophylaxis, have now become the standard (Steketee et al. 1988b; Mount et al. 1989).

Drug efficacy studies: acute illness

Refined the goal of drug use in antimalarial therapy. Traditionally, the goal of malaria therapy had been to eliminate parasitemia entirely. However, in a 1984 CCCD-sponsored study in Malawi, investigators believed that in areas where malaria reinfection was likely to recur soon after treatment, clearing parasitemia to resolve an acute febrile episode was not necessary (Khoromana et al. 1986). Thus, in the early years of CCCD, the goal of treatment for uncomplicated malaria was to provide resolution of the symptoms of malaria (Breman and Campbell 1988). Although infection is necessary for an individual to develop immunity to malaria disease, persistent parasitemia may cause anemia, which can be life threatening. Information provided by later studies in Malawi and Kenya of children with malaria parasitemia and very low hemoglobin concentrations (<8 g/dL) demonstrated the need for parasite clearance for at least 1 month to allow clinical and hematologic recovery, particularly in children less than 3 years of age, who were identified to be at greatest risk for anemia and anemia-associated mortality (Bloland et al. 1993). A single treatment dose of SP provided the necessary parasite clearance in these studies. Consequently, understanding the goal of drug use became clearer, and parasite clearance for at least 1 month was found to ensure resolution of febrile illness and hematologic recovery in young children.

Assisted malaria-endemic countries with developing national policy for dosing regimens in response to increased knowledge of antimalarial drug efficacy. In Malawi, when 25 mg/kg of CQ base over a 3-day period was more effective than a single dose of 10 mg/kg (Khoromana et al. 1986), this dosage became the CCCD recommendation, as well as Malawi's national malaria treatment policy. Although Togo found that a single dose of 10 mg/kg of CQ base was effective in 1984, the government decided to adopt a 25 mg/kg policy in 1989 as CRPF spread across Africa. Côte d'Ivoire also adopted the same policy of 25 mg/kg in 1986, even after finding that a single dose of 10 mg/kg of CQ base was effective (Soro et al. 1989).

A 1985 study in several regions of Zaire evaluated both a single dose of 10 mg/kg and a dosage of 25 mg/kg given over 3 days. Because of the greater decrease in parasitemia and fever with 25 mg/kg, even among children with resistant parasites, Zaire's MOH adopted 25 mg/kg as first-line treatment for their national malaria control plan (Paluku et al. 1988).

The standard treatment in 1986 in Rwanda of 50 mg/kg of CQ base over 6 days, representing the dosage prevalent in Burundi and Zaire in the 1970s and 1980s, was shown to be no more effective than 25 mg/kg over 3 days (Sexton et al. 1988). This information led Rwanda's MOH to recommend the lower dosage.

Found evidence, on the basis of results of parasitologic and clinical responses, to support a change from CQ as a first-line drug. Chloroquine was retained as the first-line drug in areas where it remained effective in reducing parasite densities and producing clinical improvement, even if parasitemia was not completely cleared. However, studies in 1990-1991 showed that alternative drugs should be considered if 7-day in vivo tests revealed clinical failure[10] and hematologic failure[11] greater than 10% (Bloland et al. 1993). The drugs that now meet the criteria of both effectiveness and affordability in areas of high resistance to *P. falciparum* in sub-Saharan Africa are combinations of a sulfa drug and a dihydrofolate reductase inhibitor (e.g., sulfadoxine- or sulfalene-pyrimethamine) (Bloland et al. 1993). CCCD studies led Malawi to change to SP as its first-line drug in 1992.

Showed that a more costly antimalarial may actually be more cost-effective. A recent study of the cost-effectiveness of antimalarial treatment used a model based on survey and surveillance data, dosages based on WHO recommendations, and direct cost of the drug to the health-care system (Sudre et al. 1992). These factors were found to have the most influence on the cost-effectiveness of an antimalarial drug: cost, compliance rates, and efficacy or the level of parasite resistance to the drug, with the prevalence of high-level drug resistance having the greatest effect. This analysis concluded that in settings of no resistance, CQ had the best cost-effectiveness ratio in cost per case cured and cost per death prevented. However, to prevent death in areas of high CQ resistance (between 14% and 31% of R III), SP, which is more expensive per dose than either CQ or amodiaquine, proved to be the most cost-effective of the three.

Documented the need in Africa to change from CQ as a first-line choice for complicated illness (severe malaria). The increasing resistance to CQ also affected drug choice for cases of severe or complicated malaria, which manifests in children as cerebral malaria or severe anemia. Studies in Southeast Asia, where CQ resistance had been documented in the 1980s, demonstrated the efficacy of quinine in cases of severe illness (Chongsuphajaisiddhi et al. 1981; Suebsaeng, Wernsdorfer, and Rooney et al. 1986). A CCCD study in Zaire in 1987, which used intravenous quinine to successfully treat children less than 13 years of age with life-threatening, chloroquine-resistant malaria, confirmed the effectiveness of quinine as a first-line drug for severe malaria in chloroquine-resistant areas of sub-Saharan Africa (Greenberg et al. 1989b), and this has been reconfirmed more recently in studies in Liberia (Bjorkman et al. 1991) and Malawi (Wirima et al. 1990).

Drug efficacy studies: perinatal infection

Studies examined the WHO recommendation that served as the CCCD strategy from 1982 to 1986 for chemoprophylaxis in pregnant women: a treatment dose (25 mg/kg total dose) followed by low-dose chemoprophylaxis (5 mg/kg weekly) with CQ (Steketee et al. 1987; Cot et al. 1992). Chemoprophylaxis was deemed neces-

[10] Clinical failure refers to the persistence of a measured axillary temperature of ≥37.5° C in a parasitemic child.

[11] Hematologic failure refers to a hemoglobin concentration in the anemia range that fails to increase after the patient receives therapy.

sary to keep the placenta parasite-free and thus reduce the risk of LBW, a risk factor for infant death.

Showed that prophylaxis with CQ or pyrimethamine was ineffective in a setting where high levels of resistance to these drugs had been documented. Chloroquine prophylaxis in pregnant women was extensively studied in Malawi, where CRPF had been confirmed in 1984. One study demonstrated that CQ prophylaxis failed to maintain pregnant women free of *P. falciparum* infection (McDermott et al. 1988). In Kenya and other countries with similar resistance levels, the same finding held true (Steketee et al. 1987). As a result, chemoprophylaxis during pregnancy with CQ was deemphasized as a recommended CCCD intervention.

In Nigeria in 1988, Nahlen and colleagues found that pyrimethamine chemoprophylaxis in either suppressive or causal prophylactic doses did not clear parasites from the blood of pregnant women (1989); prophylaxis with pyrimethamine was therefore discouraged in Nigeria.

Documented that poor compliance is a major obstacle to the effectiveness of chemoprophylaxis for pregnant women. The decreasing levels of CQ efficacy were further compromised by low levels of compliance to a weekly regimen of chemoprophylaxis. Even with CQ available, few women in surveys in four countries (CAR, Liberia, Togo, and Zaire) were found to be complying with the recommended regimen of weekly CQ prophylaxis. Data from Malawi also showed low rates of compliance—36% of the women in the study had urine CQ metabolite levels compatible with regular compliance to the weekly CQ dosage schedule, even when the drug was known to have been received by the women free of charge (Heymann et al. 1990). Low levels of compliance reduced the effectiveness of a chemoprophylaxis program for pregnant women.

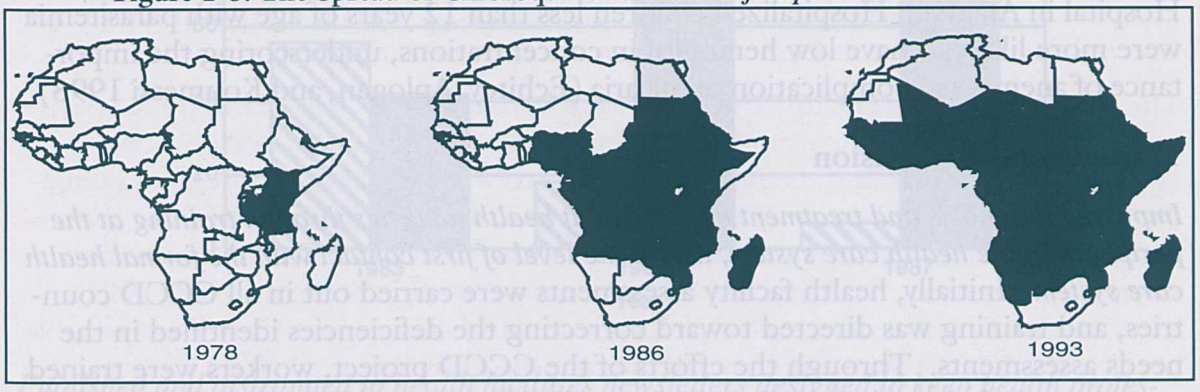
Found alternative drugs effective in a program of intermittent therapy or chemoprophylaxis for pregnant women. The MMRP found that MQ in treatment (750 mg) followed by weekly prophylaxis (250 mg) doses was far superior to treatment and/or weekly prophylactic doses of CQ in clearing peripheral parasitemia and placental malaria infection and in reducing the frequency of LBW. However, MQ did not meet one of the critical requirements for use in chemoprophylaxis programs: affordability. More recently, a project in Malawi found that intermittent use of two treatment doses of SP, one given at the first antenatal clinic visit and the second at the beginning of the third trimester, linked to routine antenatal care, was effective in clearing peripheral and placental infections at the time of delivery (Schultz et al. 1993a). In addition, this regimen was more cost-effective than other alternatives in Malawi (Schultz et al. 1993b).

Drug sensitivity surveillance systems

Established national systems of monitoring sensitivity of Plasmodium falciparum *to antimalarials, thereby chronicling the spread of CRPF across Africa.* CCCD assisted participating countries in establishing ongoing drug sensitivity surveillance systems. National or regional teams collected data at regular intervals on the parasite's response to CQ and to second-line drugs, such as amodiaquine, SP, quinine, and

MQ. Surveillance systems were established in 7 of 12 malaria-endemic CCCD countries (CAR, Congo, Malawi, Nigeria, Rwanda, Togo, and Zaire), and sporadic testing using the CCCD protocol was done in Côte d'Ivoire, Guinea, Liberia, and Swaziland. These countries documented the progression of CRPF across Africa, as well as within individual countries (Fig. 1-5).

Figure 1-5. The Spread of Chloroquine-resistant *P. falciparum* Malaria in Africa



Insecticide-impregnated bed nets

Found that insecticide-impregnated bed nets and curtains prevent malaria. Two studies in Kenya, a 4-month investigation in 1988 and a longer study starting in 1990, investigated the efficacy of permethrin-impregnated bed nets and curtains (Sexton 1990). Results showed that entomologic, parasitologic, and clinical indices improved with the use of these mosquito barriers and confirmed findings from studies in The Gambia (Alonso et al. 1993). During the low transmission season, bed nets offered greater protection against infection than curtains covering ceiling eaves, windows, and doors. During the season of high transmission, this protection may be less pronounced; bed nets reduced the frequency of infection but did not prevent infection entirely (Beach et al. 1993).

Support Components

Surveillance and health information systems

Of the CCCD countries, Burundi, CAR, Malawi, Nigeria, Rwanda, Swaziland, Togo, and Zaire established or improved a formal reporting system of disease surveillance, which included routine reporting of malaria.

Collected data from hospitals that enabled many Ministries of Health to monitor trends in diseases of public health importance, including malaria. The countries mentioned above have developed the ability to monitor disease burden (number of admissions, outpatient visits, CFRs) over time, increasingly with the use of microcomputers.

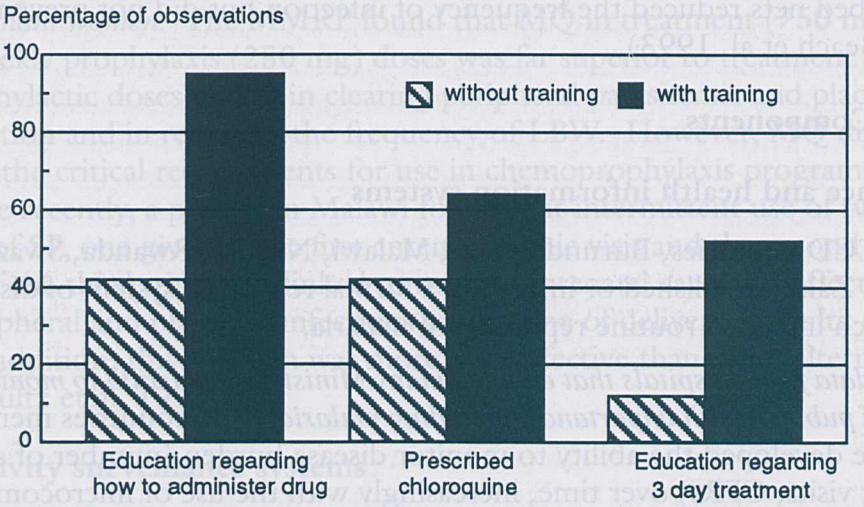
Timely dissemination of annual reports based on surveillance data enabled program managers to design appropriate disease control strategies and operational research. Bulletins and reports are being prepared within a few months after the end of a reporting period, rather than years later as occurred in the past. In 1989, in part as a

result of data from the national health information system in Malawi demonstrating the worsening malaria disease burden and low efficacy of existing programs, the national strategy was revised and treatment guidelines developed. Review of the surveillance system in the Pediatrics Department of the University Hospital Center in Lome, Togo, identified an association between malaria and anemia and led to a study of the relationship between childhood malaria infection and anemia at St. Jean's Hospital in Afagnan. Hospitalized children less than 12 years of age with parasitemia were more likely to have low hemoglobin concentrations, underscoring the importance of anemia as a complication of malaria (Echitey, Aplogan, and Koumessi 1993).

Training and supervision

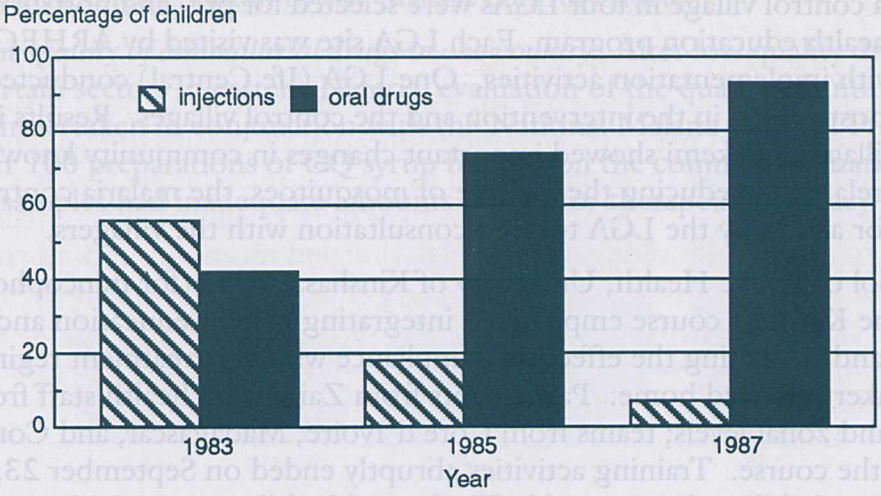
Improved diagnosis and treatment of malaria at health facilities through training at the periphery of the health care system, i.e., at the level of first contact with the formal health care system. Initially, health facility assessments were carried out in all CCCD countries, and training was directed toward correcting the deficiencies identified in the needs assessments. Through the efforts of the CCCD project, workers were trained to manage malaria patients by using standardized treatment algorithms (Fig. 1-6). Facility assessments demonstrated improvements in the diagnosis and treatment of malaria at all levels of health delivery. The use of injections to treat acute malaria illness dropped from 47% to 9%-28% in selected areas of Togo after health workers underwent an intensive training and supervision program to provide oral antimalarial drugs (Fig. 1-7). Indices reflecting adequate provision of services at the peripheral level should improve substantially with activities undertaken as a result of the Malaria Initiative.

Figure 1-6. Treatment and Information Given to Mothers of Febrile Children in Rural Health Facilities by Participation in Training in Côte d'Ivoire, 1991



Côte d'Ivoire, 1991: 38 observations in 15 facilities

Figure 1-7. Malaria Treatment Practices with Injections or Oral Drugs, Togo, 1983-1987



Published and distributed to health facilities newsletters designed to keep health professionals abreast of current policies regarding disease treatment and prevention. The Central African Republic published *The DMPGE* (*Département de Médecine Préventive et Grandes Endémies*) *Echo*, Zaire's publication was titled *Sauvons nos Enfants* (Let's Save Our Children), Burundi published *Bulletin Epidémiologique de Burundi,* and Nigeria named its publication *Nigeria Bulletin of Epidemiology.*

Successfully employed the strategy of Technical Cooperation between Developing Countries. To collect drug sensitivity data to be used in developing a national malaria strategy, CCCD national public health officials and microscopists went from Malawi to Swaziland and from Zaire to Guinea. National malariologists from Nigeria, Togo, and Zaire have served as malaria control consultants within Africa for WHO and for CDC. The CCCD program managers have become recognized as important authorities on malaria control in Africa by virtue of the successful activities they conducted within their countries and the prominent roles they played regionally and internationally.

Health education

Conducted two 4-week intercountry workshops. The theme of malaria control was selected by the African Regional Health Education Center (ARHEC) in Ibadan, Nigeria, in l990 and by the School of Public Health, University of Kinshasa, Zaire, in l991 for the annual short course in health education planning and management. Both workshops focused on planning a health education program based on the national malaria control strategies of participants' countries.

The African Regional Health Education Center in Ibadan, Nigeria: The ARHEC workshop trained primary health care teams from four Local Government Areas (LGAs) in Nigeria and national personnel from Kenya, The Gambia, and Swaziland, receiving support from the CCCD Project. Health education plans were based on one of four key control strategies: early diagnosis and treatment, personal protection,

vector control, and chemoprophylaxis of pregnant women. In Nigeria, an intervention and a control village in four LGAs were selected for pre- and postsurveys to evaluate the health education program. Each LGA site was visited by ARHEC staff, who assisted with implementation activities. One LGA (Ife Central) conducted both the pre- and postsurveys in the intervention and the control villages. Results in the intervention village of Yekemi showed important changes in community knowledge and practices related to reducing the menace of mosquitoes, the malaria control strategy selected for action by the LGA team in consultation with the villagers.

The School of Public Health, University of Kinshasa, Zaire (for francophone countries): The Kinshasa course emphasized integrating patient education and case management and evaluating the effect on compliance with the treatment regimen once the caretaker returned home. Participants from Zaire were health staff from the national and zonal levels; teams from Côte d'Ivoire, Madagascar, and Congo also attended the course. Training activities abruptly ended on September 23, 1991, when severe civil disorder erupted in Kinshasa. No follow-up activities were possible because the United States Agency for International Development (USAID) program in Zaire was terminated.

Trained health educators and social scientists in CAR, Côte d'Ivoire, Guinea, Nigeria, Rwanda, and Togo to conduct formative research as part of malaria-related health education program development. Results of the research were used to prepare a quantitative survey instrument (Côte d'Ivoire); explore factors related to knowledge and behavioral results of a larger quantitative survey (Togo); assess community needs in malaria control (Nigeria); and define behavioral objectives for patient and community education (CAR, Guinea, Rwanda).

Developed a prototype curriculum in 1992 that could be used at African national workshops to improve malaria case management through patient education. At a 2-week workshop in Congo, consultants, including African malaria program managers, epidemiologists, health educators, and representatives from the African Regional Office of WHO, A.I.D., and CDC, visited busy urban clinics, observed deficiencies in the patient education process, and demonstrated to clinic workers ways in which communication with patients could be integrated into the case management process. Curriculum guidelines were then prepared on the basis of workshop participants' experience in the clinics.

Logistics

Identified problems and potential solutions for shortages of antimalarial drugs and diagnostic resources (e.g., thermometers and microscopes) in health facilities. Assessments of health facilities in two areas of Nigeria in 1991 revealed varying levels of the availability of drugs and diagnostic equipment. An assessment of the 11 health facilities in Nsukka found that CQ was not in stock at most facilities, and just over half the facilities had thermometers. Another assessment in the 13 health facilities in Barkin-Ladi found that all facilities had CQ in stock, but that most had neither reagents nor supplies necessary for laboratory diagnosis of malaria. Although early CCCD efforts

did not focus on this aspect of the health system, later work emphasized logistics, which is key to implementation of any malaria control effort.

Evaluated the quality of antimalarial drugs in one country. After low quality drugs were found in certain sectors in eastern Nigeria, evaluation of the quality of antimalarial drugs was undertaken in conjunction with the National Malaria Control Program. Among over 100 preparations of CQ syrup bought on the commercial market, 34%-39% of the samples had inadequate amounts of CQ for therapeutic efficacy.

SECTION III
PROGRESS TOWARD CCCD TARGETS

The success of CCCD's malaria component must be measured against the goals, objectives, and targets established for the CCCD project. The main goal of the CCCD project was to help African nations improve the health of their children by reducing morbidity and mortality caused by vaccine-preventable illnesses, diarrheal diseases, and malaria. In 1981-1983 objectives were established that focused on strategies to achieve this reduction in malaria-related morbidity and mortality: case management at home, in the community, and at health facilities and chemoprophylaxis for pregnant women. After several years of field experience, targets were introduced to monitor and evaluate programs; these targets were revised periodically to reflect national, regional, and global experience.

Table 1-2. CCCD Malaria Objectives and Targets

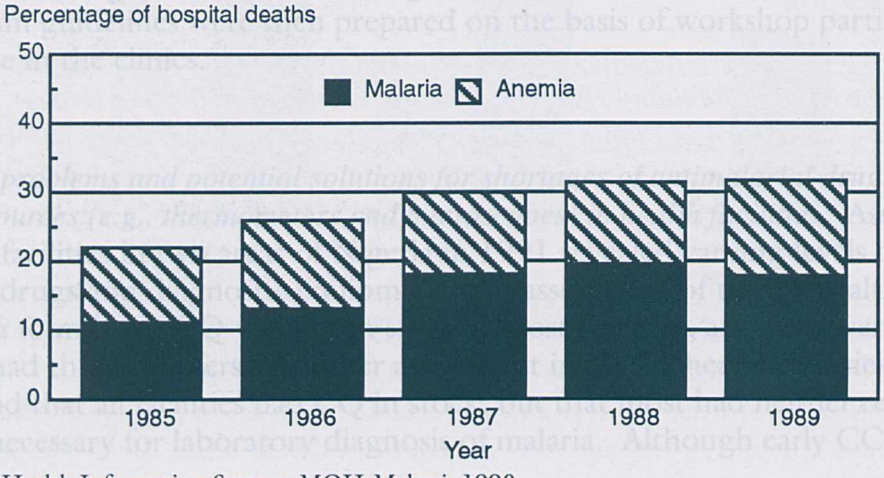
Objectives	Targets
Inpatient malaria mortality	Reduce by 50%
Home/community treatment	50% correct treatment
Health facility management	90% correct management
Chemoprophylaxis for pregnant women	Not specified

Objective: To reduce inpatient malaria mortality by 50%

Experiences:

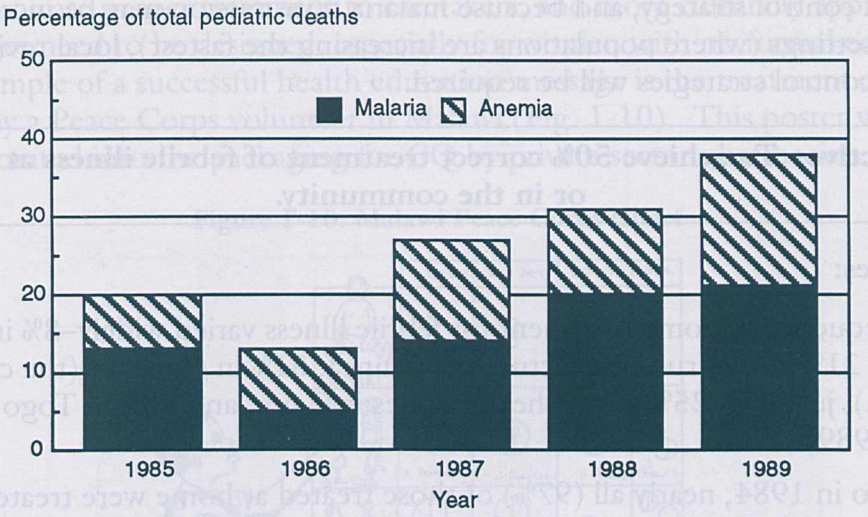
Data from Malawi and Togo suggest that the proportion and number of malaria-related inpatient deaths have risen (Figs. 1-8 and 1-9). Although surveillance has certainly improved, it is unlikely that these observations are due to improved reporting.

Figure 1-8. Children Under 5 years, Hospital Deaths due to Malaria and Anemia, Malawi, 1985-1989



Health Information System, MOH-Malawi, 1990

Figure 1-9. Anemia and Malaria Deaths, Child Health Unit, Lome, Togo, 1985-1989



Conclusions:

- The target of a 50% reduction was not achieved. In fact, evidence suggests that malaria-associated mortality increased in a number of the CCCD countries. There are several possible explanations for the reported increased malaria-associated mortality: (1) improved surveillance, although this was not the case with other conditions such as chicken pox or diarrheal disease; (2) increased malaria transmission, particularly in urban settings where populations are growing the fastest and where large hospital and attached clinic-based reporting may be the most developed; (3) poor response of the malaria parasite to CQ treatment; (4) malaria-associated anemia that previously has not been recognized and managed as a malaria problem; and (5) inadequate therapy and consequent mortality as a result of poorly implemented case management strategy and unavailability of alternative drugs.
- During the CCCD Project, malaria control measures were introduced in chloroquine-resistant areas. Earlier in the project, the progression of CRPF and efficacy of antimalarial drugs could not be measured because of the lack of a surveillance system. In addition, programs and infrastructures for delivering treatment and prevention were not functioning effectively. Although improvements were made in recognizing the efficacy of CQ and instituting rational treatment guidelines in many settings, they were not sufficient to prevent the increase in malaria-associated morbidity and mortality.

Lessons Learned:

- In Africa, poor parasite response to the most widely available antimalarial drug has been a formidable obstacle in reducing mortality. This problem, as well as ineffective disease management in homes and health facilities, must be addressed to improve child survival.

- Because malaria-associated anemia results in many deaths and requires a specific malaria control strategy, and because malaria transmission may be increasing in urban settings (where populations are increasing the fastest), local revisions of urban control strategies will be required.

Objective: To achieve 50% correct treatment of febrile illness at home or in the community.

Experiences:

- The frequency of home treatment for febrile illness varied widely–8% in Rwanda, 13% to 21% in two rural prefectures of Guinea, 51% in Conakry (the capital of Guinea), just over 25% in two health zones in Zaire, and 83% in Togo (Deming et al. 1989).
- In Togo in 1984, nearly all (97%) of those treated at home were treated within 24 hours of fever onset. The dosage of CQ, the antimalarial used by 94% of the caretakers, was considered insufficient for more than 70% of home treatments because less than 10 mg/kg was given during the first full day of treatment.
- In Conakry, Guinea, in 1986, 79% of the febrile children were given antimalarial drugs by their caretakers; however, the dosage given at home was considered inadequate for 70% of those treated (Dabis et al. 1989).
- A 1992 Knowledge, Attitudes, and Practices study in Malawi showed that of the caretakers who did not take their febrile child for treatment at a clinic, only 42% gave the child an antimalarial drug; of the children who were given an antimalarial, 91% were treated within 48 hours of fever onset, as recommended. Of all febrile children not taken to a clinic, only 4.5% received optimal treatment, defined as proper age-specific dosage of CQ within 2 days of fever onset (Slutsker et al. 1993b). Mothers with higher levels of education were more likely to treat their children appropriately at home with an antimalarial drug or to take them to a health facility.

Conclusion:

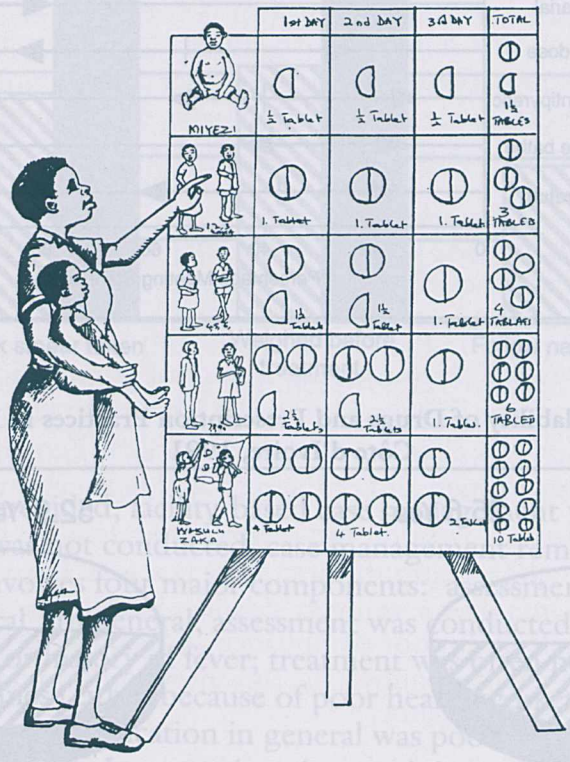
Progress toward reaching the target of appropriate treatment varied among the CCCD countries, depending on the extent of coverage and the timing and amount of drug administered. Many children were given treatment at home for their fevers, and in several areas, the proportion far exceeded the target of 50%. The problem was that children often received insufficient dosages for their ages and weights, and thus their treatment was ineffective.

Lessons Learned:

- The CCCD Project gained considerable knowledge regarding behavior related to home antimalarial treatment. Although children received home treatment with an antimalarial drug for perceived febrile illness, the dosage given was not appropriate. Consequently, health educators must increase their efforts to address the issue of proper dosages for age or weight in young children.

- Posters and other forms of health education provide an important opportunity to communicate proper treatment to caretakers, and more culturally appropriate messages need to be designed, especially for women with no formal education. An example of a successful health education message is the treatment chart developed by a Peace Corps volunteer in Malawi (Fig. 1-10). This poster was also incorporated into the packaging for CQ by private sector pharmacists.

Figure 1-10. Malawi Peace Corps Chart



Objective: To achieve 90% correct management of febrile illness in health facilities

Experiences:

- Problems impeding malaria treatment in health facilities included limited availability of drugs, improper dosage regimens, and lack of clear instructions for follow-up. Facility assessments in eight CCCD countries identified performance problems (Fig. 1-11), and one 1991 survey revealed that approximately three-fourths of Côte d'Ivoire's health facilities had no CQ (its first-line drug) in stock (Fig. 1-12).

Figure 1-11. Febrile Illness Treatment Practices in 8 CCCD Countries

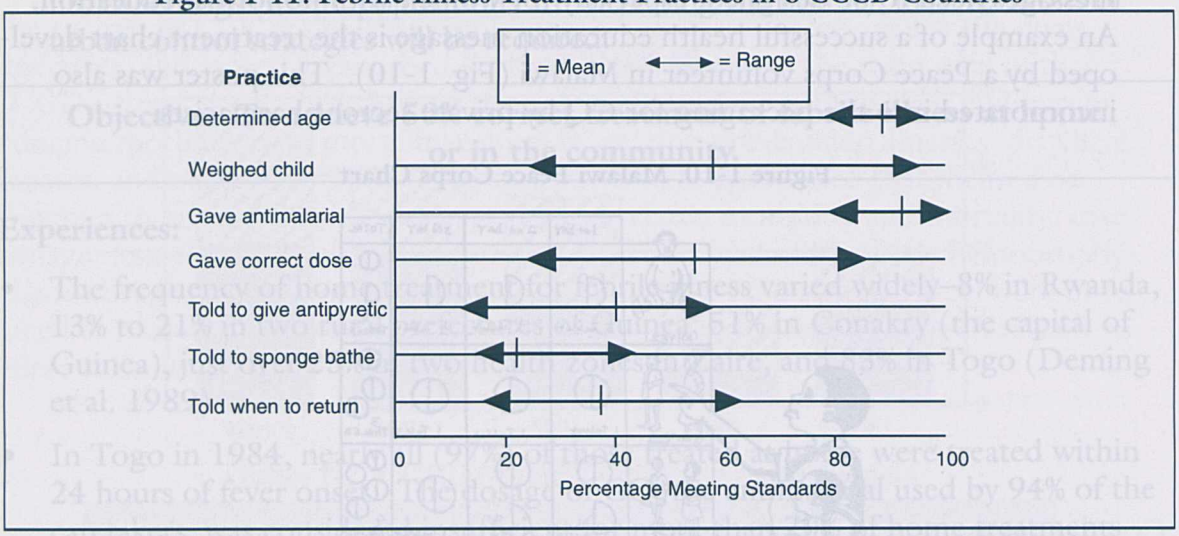
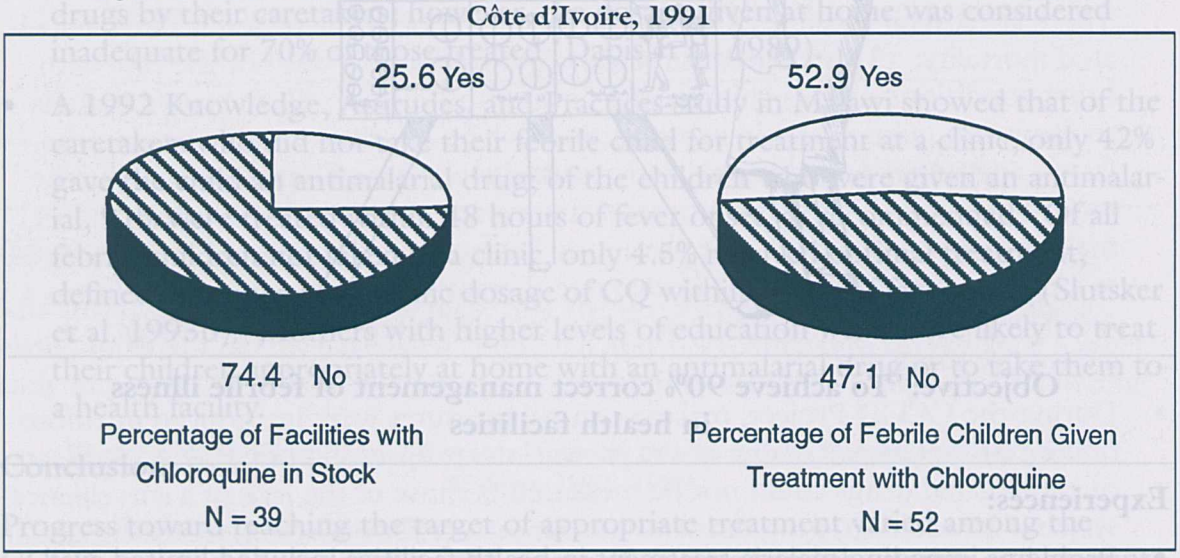


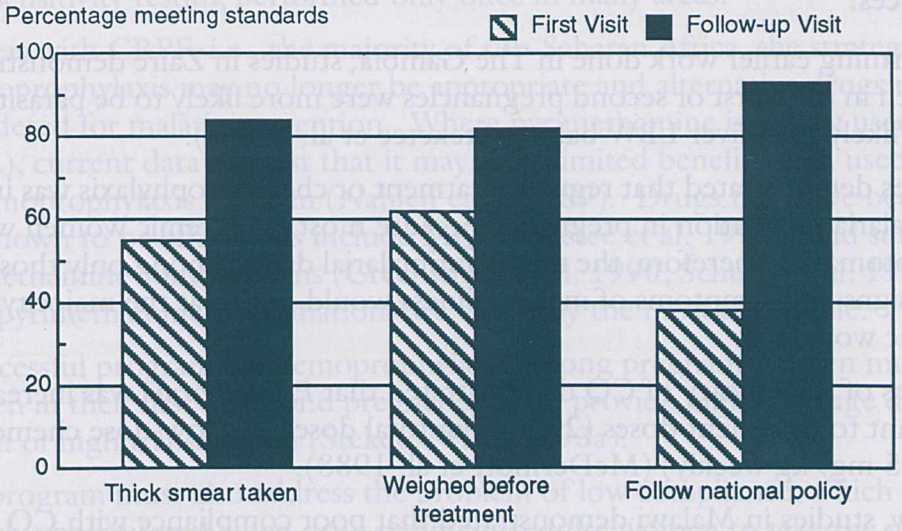
Figure 1-12. Availability of Drugs and Prescription Practices in Health Facilities, Côte d'Ivoire, 1991



Facility assessment surveys, Côte d'Ivoire, 1990

- Changes in health facility care were evaluated through repeat facility needs assessments conducted in several countries. In the countries resurveyed, the quality of care was shown to improve after training had been conducted (Fig. 1-13).

Figure 1-13. Percentage of Health Facilities Meeting Standards for Malaria Practices at First and Follow-up Visits, Rwanda, 1987



Conclusions:

Where training was provided, facility-based case management was improved. In facilities where training was not conducted, case management remained unsatisfactory. Case management involves four major components: assessment, treatment, health education, and referral. In general, assessment was conducted in a standard fashion by recognizing fever or history of fever; treatment was often not provided according to established guidelines (either because of poor health worker knowledge or lack of appropriate drugs); health education in general was poor; and referral criteria and conduct were not assessed. In countries where training was based on needs assessments and quality was monitored, improvements were consistently observed.

Lessons Learned:

- In many facilities and community programs, the lack of antimalarial drugs such as CQ and SP was a barrier to treatment. Poor management and logistics weakened the ability of facilities to provide appropriate treatment. Health facilities, especially those at the periphery, are dependent on adequate stores of drugs and other needed supplies. These problems underline the urgent need to assess and improve the drug supply system in many countries.
- Since health staff and persons in communities preferred treatment practices of the past, such as injections, efforts to improve and standardize treatment practices were hindered. Effective preservice and inservice training programs can improve quality of care at health facilities, but unless the health system can ensure availability of drugs, health facilities cannot provide quality services.

Objective: To implement CQ prophylaxis of pregnant women.[12]

Experiences:

- Confirming earlier work done in The Gambia, studies in Zaire demonstrated that women in their first or second pregnancies were more likely to be parasitemic and more likely to deliver LBW babies (Steketee et al. 1988a).
- Studies demonstrated that regular treatment or chemoprophylaxis was important for malaria prevention in pregnancy because most parasitemic women were asymptomatic. Therefore, the use of antimalarial drugs among only those women with signs and symptoms of malaria illness would not treat the majority of parasitemic women.
- Studies of the efficacy of CQ demonstrated that *P. falciparum* was increasingly resistant to treatment doses (25 mg/kg total dose) and low-dose chemoprophylaxis (5 mg/kg weekly) (McDermott et al. 1988).
- Finally, studies in Malawi demonstrated that poor compliance with CQ prophylaxis (in a program where CQ is given to the woman to take weekly at home) caused this already poorly effective drug to be of little benefit in reducing malaria infection in pregnant women and reducing LBW in their babies (Heymann et al. 1990).

Conclusions:

- Because of drug resistance, poor compliance, and the consequent low program effectiveness of CQ chemoprophylaxis, this intervention was not stressed in the last years of CCCD (1987-1993).
- Further studies were conducted to examine the actual benefit of chemoprophylaxis as well as to examine more effective antimalarial drugs. The MMRP found that women in their first and second pregnancies were at greatest risk for malaria-associated LBW and therefore should be targeted for chemoprophylaxis. The MMRP also examined the effect on birth weight of MQ, an antimalarial drug known to be effective; the use of MQ resulted in decreased incidence of LBW. These findings led to a study that tested a regimen that would be both affordable and practical to implement: intermittent treatment with SP, given under observation at first antenatal clinic visit (usually in the middle of the second trimester) and again at the beginning of the third trimester (with a minimum interdose interval of 1 month) (Schultz et al. 1993a). This regimen proved to be affordable and effective not only in reducing the incidence of placental malaria infection but also in increasing compliance. As a result of these findings, the policy in Malawi has been revised. This regimen should be evaluated in other settings, and its implementation in Malawi and elsewhere must also be examined before it is recommended for use throughout the region.

[12] The appropriateness of chemoprophylaxis for all pregnant women was called into question after a number of studies were conducted and before targets were stated. No target was specified for this objective.

Lessons Learned:

- Drug sensitivity should be monitored to document changes in intensity of parasite resistance to drugs. Repeated monitoring in selected areas is more valuable than sensitivity testing performed only once in many areas.
- In areas with CRPF, i.e., the majority of sub-Saharan Africa, the strategy of CQ chemoprophylaxis may no longer be appropriate and alternative drugs must be considered for malaria prevention. Where pyrimethamine is widely used (West Africa), current data suggest that it may offer limited benefit when used alone in a chemoprophylaxis regimen (Nahlen et al. 1989). Drugs that have been tested and shown to be efficacious include MQ (Steketee et al. 1993a) and sulfa-pyrimethamine combinations (Greenwood et al. 1990; Schultz et al. 1993b); the sulfa-pyrimethamine combinations are currently the most affordable.
- A successful program of chemoprophylaxis among pregnant women must target women in their first or second pregnancies and provide high coverage during the season of high transmission (Steketee et al. 1993a).
- The program must also address the problem of low compliance, which is frequently encountered when drug regimens require women to take the medications at home. A drug that would limit poor compliance, e.g., one with a long half-life such as SP, could be given as intermittent treatment (shown to be effective with as few as two treatment doses in pregnancy) under supervision at clinics. Health education for pregnant women can improve compliance by stressing the need to visit antenatal clinics at least twice during pregnancy. Antimalarial chemoprophylaxis should be available through a program of antenatal care convenient for the pregnant women.

SECTION IV
PRIORITIES FOR MALARIA CONTROL IN THE NEXT DECADE

CCCD achievements and lessons learned have focused priorities for malaria control in sub-Saharan Africa in the coming decade.

Malaria imposes a great burden on the children and nations of this region. The impact of the disease cannot be ignored; it must be confronted.

- Malaria is one of the major causes of mortality among children less than 5 years of age in sub-Saharan Africa. Of all children who become ill with malaria, 1% to 2% will die from severe malaria. The human cost of malaria-associated anemia in Africa is just beginning to be understood. Malarial anemia is associated with 10% to 30% of in-hospital pediatric deaths and may be an important cause in up to 75% of malaria-associated pediatric deaths.

- Malaria exacts a tremendous economic toll on families and nations.

The epidemiology of malaria is now much better understood. At-risk persons are better identified, and coherent malaria control strategies have been developed; these must be implemented.

- The target groups are children younger than 5 years of age and pregnant women. After the age of 5 years, children begin to develop immunity that protects them from the most severe complications of malaria infection. Pregnant women, especially those in their first, and possibly in their second, pregnancies, lose the immunity they have to adverse effects of malaria infection and are susceptible to adverse consequences of placental parasitemia.

- Case management is the prime focus of control. Because of extensive drug efficacy testing, drug-resistance monitoring, and surveillance system development, more is known about which drugs are efficacious and what constitutes an effective dosage regimen.

Prompt case management with an effective antimalarial drug will reduce malaria-related morbidity and mortality. This case management strategy for acute malaria/febrile illness in children must be implemented.

- At the outset, the strategy was to deliver a low dosage of CQ to at-risk groups. For children, the strategy was to treat individual cases of malaria. Because of the drug testing conducted and the surveillance systems established, the increase in CQ resistance across Africa could be monitored, and alternative antimalarial drugs could be evaluated. Increasingly, in many areas, CQ resolved neither the symptoms nor the parasitemia caused by malaria; furthermore, severely anemic

children responded less well to CQ than to SP. With this information, one country (Malawi) adopted a more effective first-line drug (SP) for acute illness. The strategy of prompt and effective treatment of malaria/febrile illness has matured, and many countries are ready to take the next step of implementing the strategy. The other components of effective case management—accurate diagnosis, patient education, and proper referral—need more attention and strengthening.

Data are now available to justify specific strategies to manage malaria in pregnant women and to manage its effects on the fetus and the newborn (perinatal malaria). Because pregnant women who become parasitemic are asymptomatic, either intermittent treatment or chemoprophylaxis is required. To be effective, the strategy chosen must be integrated into existing antenatal health programs.

- Control of the effects of antenatal and perinatal malaria proved to be a far greater challenge than anticipated, principally because of the ineffectiveness of the drug recommended as prophylaxis during pregnancy. Pregnant women, especially in their first or possibly their second pregnancies, are susceptible to placental malaria infection, a risk factor for LBW, which in turn is associated with higher infant mortality. Poor compliance to weekly drug regimens limited the effectiveness of prophylaxis programs in pregnant women. CCCD activities found that a single dose of an effective drug at two clinic visits constitutes an effective strategy and reduces problems with compliance; this strategy should be used in antenatal health programs.

With improved case management strategies, acute illness and its potential progression to anemia can be managed. However, case management cannot prevent the initial infection. Because of the danger of repeated infections in children, there is a need to prevent mosquitoes from biting their young victims.

- Insecticide-impregnated bed nets have proven to be a promising method to decrease malaria-associated morbidity and mortality in settings of low malaria transmission. This control method requires many technical, programmatic, and economic resources; therefore, bed nets should currently be used where experienced technical groups and communities can properly support and maintain them. If further testing of the efficacy and effectiveness of bed nets continues to show positive results, and if implementation plans can be developed, evaluated, and shown to be workable, bed nets should be recommended and promoted as an effective tool for malaria control.

A critical factor in malaria control is national health care leadership and infrastructure. National institutions must have clear and detailed written policies and plans that include management and logistics provisions to support malaria control within the country's borders.

- The consequences of inadequate health infrastructures in CCCD countries were evident: lack of antimalarial drugs in health facilities, limited surveillance, ineffective training programs, and inadequate disease surveillance and evaluation systems. Most sub-Saharan African countries are currently trying to resolve these problems. The national leadership must provide adequate resources to ensure a viable infrastructure for the system to work. CCCD leadership in policy and programming workshops initiated a process that many of the CCCD countries have used and can continue to use to improve their national malaria policies, plans, and implementation.

Malaria control must link scientifically based strategies with rational and feasible operations.

- Case management and prevention strategies using effective antimalarial drugs and control methods will decrease malaria morbidity and mortality. However, continued monitoring and evaluation of those strategies must be undertaken to ensure that the most cost-effective approaches are being used. Malaria control is not easy—the disease overlaps with many others, and its control requires attention to behavioral, biologic, clinical, and epidemiologic issues. A malaria vaccine is still not available, but remains on the horizon. Thus, operational research tied to field operations will remain an important priority for countries and for international agencies committed to malaria control in Africa.

The priority for the 1990s is to translate the lessons learned and the information gained into action. A critical feature of this action will be the documentation of the effect of control actions on malaria-related morbidity and mortality.

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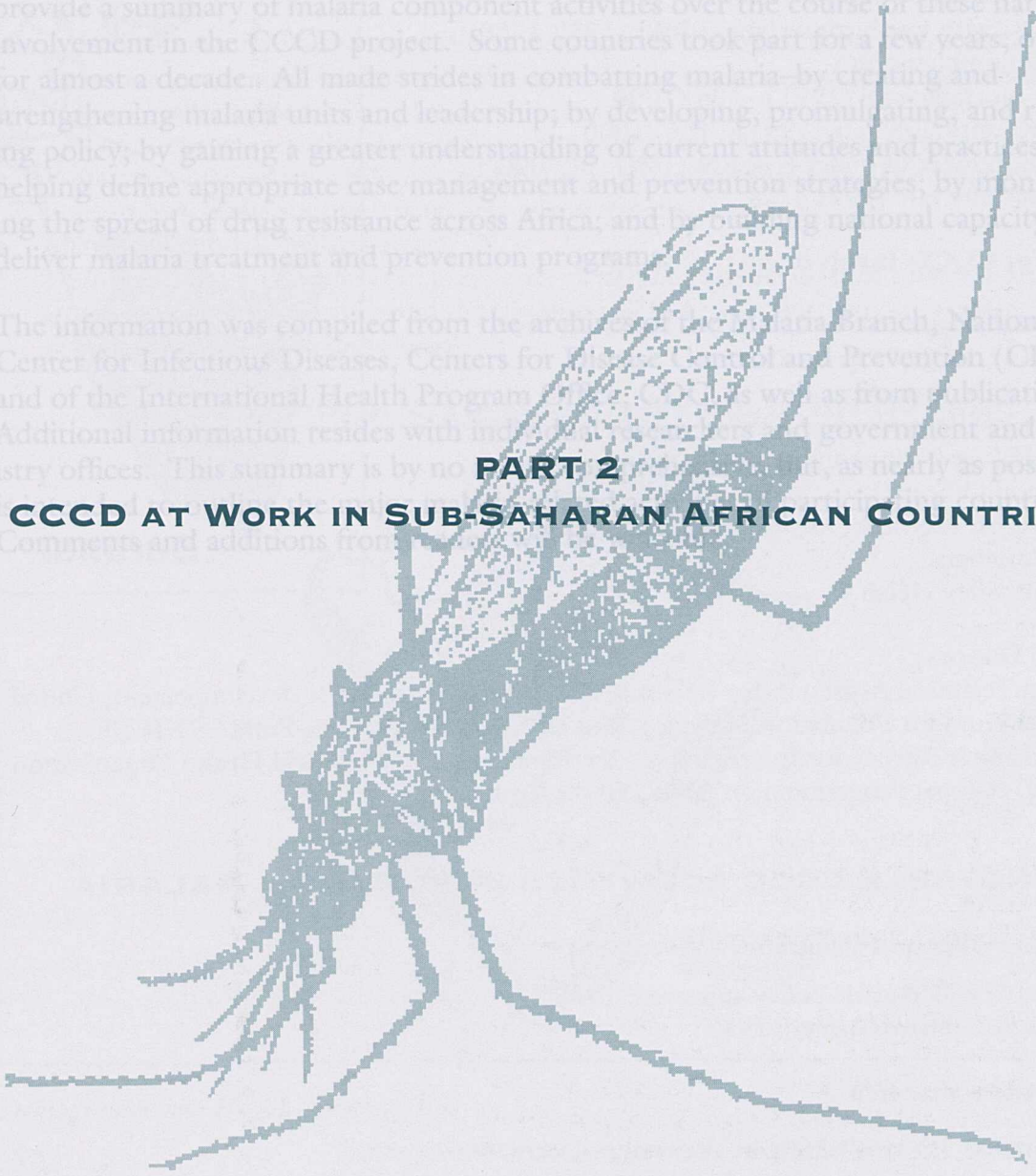
*Work funded either in part or in full by CCCD.



PART 2

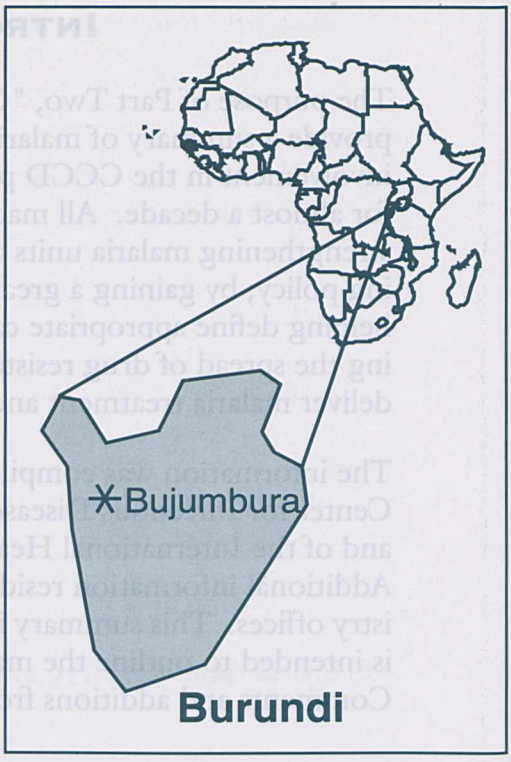
CCCD at Work in Sub-Saharan African Countries

Introduction to Part Two

The purpose of Part Two, "CCCD At Work in Sub-Saharan African Countries," is to provide a summary of malaria component activities over the course of these nations' involvement in the CCCD project. Some countries took part for a few years, others for almost a decade. All made strides in combatting malaria–by creating and strengthening malaria units and leadership; by developing, promulgating, and refining policy; by gaining a greater understanding of current attitudes and practices; by helping define appropriate case management and prevention strategies; by monitoring the spread of drug resistance across Africa; and by building national capacity to deliver malaria treatment and prevention programs.

The information was compiled from the archives of the Malaria Branch, National Center for Infectious Diseases, Centers for Disease Control and Prevention (CDC), and of the International Health Program Office, CDC, as well as from publications. Additional information resides with individual researchers and government and ministry offices. This summary is by no means comprehensive, but, as nearly as possible, is intended to outline the major malaria-related activities in participating countries. Comments and additions from readers will be welcome.

BURUNDI



Country Data
Population (1991): 5,700,000
% infants with low birth weight (LBW) (1980-1988):
9 (Bujumbura only)
Infant mortality rate (1991): 108/1000
Under-5 mortality rate (1991): 181/1000
Annual number of under-5 deaths (1991): 47,000
Total fertility rate (1991): 6.8

Years of CCCD Involvement: 1985-1993

National Organization and CDC Resident Staff
National CCCD Program Director:
Dr. Fidele Bizimana
National Malaria Coordinator:
Dr. Hilaire Ndihokubwayo
Technical Officers:
Mr. Cyril Pervilhac, Mr. Robert Weierbach
Epidemiologist:
Dr. Bradley Hersh

Major Donors
Belgian Technical Assistance for Burundi, Fonds Européen pour le developpement, United Nations Fund for Population Activities, United Nations Children's Fund (UNICEF), United States Agency for International Development (A.I.D.), World Health Organization (WHO)/Global Programme on AIDS, World Bank

NOTABLE CCCD ACTIVITIES IN BURUNDI: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1988
Malaria coordinator named: 1988

Operations Research

Drug Studies (in vivo testing by national or international teams)

1989

- Conducted a study of in vivo responses of *P. falciparum* to chloroquine (CQ) and sulfadoxine-pyrimethamine (SP) in Nyanza Lac

Health Unit Practices Surveys

1987
Carried out needs assessment in Ngozi Region to determine quality of health worker care of malaria patients

- Over a third (35%) weighed child
- 67% took temperature

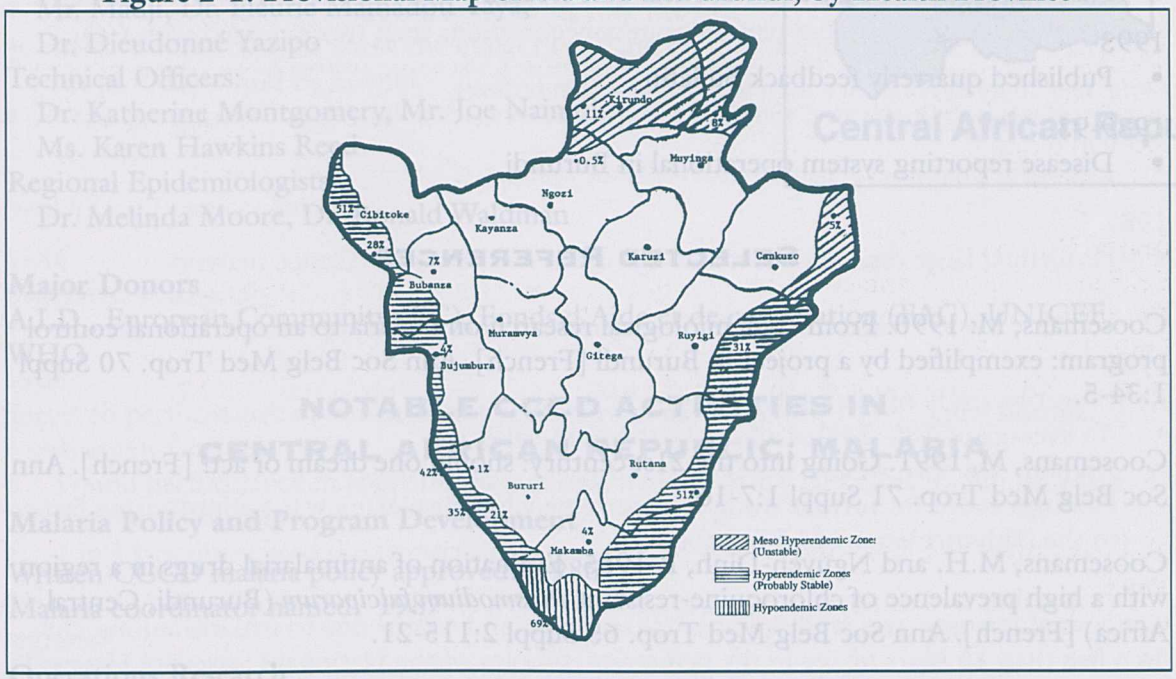
- More than 7 in 10 (71%) children treated at center
- 0-5% educated the mother regarding follow-up treatment
- Nearly half (49%) of those given antimalarials received correct treatment

1989

Conducted survey of malaria treatment practices by health workers in 65 health centers

- Identified problems in knowledge (25% of health facilities) and irregular supplies of CQ (22% of health facilities)
- 75% of nurses knew national strategy for the treatment of febrile episodes with CQ
- Proportion of children without fever having parasitemia varied from 0% at high elevations to 69% in the southern plain area of the country (Fig. 2-1)
- Identified high-risk malaria areas
- Found significant differences in prevalence of parasitemia: parasitemia primarily a problem in low-lying inland areas and the lakeshore area of the country; malaria control activities then intensified in these areas

Figure 2-1. Provisional Map of Malaria in Burundi, by Health Province



Demographic and Health Survey (DHS)

1987

- 8% of 3,456 children younger than 5 years of age had a fever in the 4 weeks prior to the survey
- Nearly 50% of febrile children went to a health center
- Approximately 20% were given antimalarials
- 22% of febrile children did not receive any treatment

Other Malaria-related Activities

1986

- 4 staff members taught in vivo drug testing in Côte d'Ivoire during CCCD training workshop

1988-89
- CCCD assisted the Ministry of Health (MOH) in the first decentralized, integrated microscopy training program; 22 technicians trained in malaria diagnosis
- Job Aids developed for malaria

1989-90
- Documented increased malaria morbidity, mortality, and case-fatality rates (CFRs)

1990-91
- Provided 60 microscopes; microscopists trained in 9 health sectors; 13 supervisors trained in microscopy
- Each of the health centers in highly malaria-endemic health sectors had a trained microscopist and a microscope
- Revised set of Job Aids (Fiches techniques) on malaria completed, printed, and made available

1992
- National epidemiologic and statistical unit created

1993
- Published quarterly feedback bulletin

1989-93
- Disease reporting system operational in Burundi

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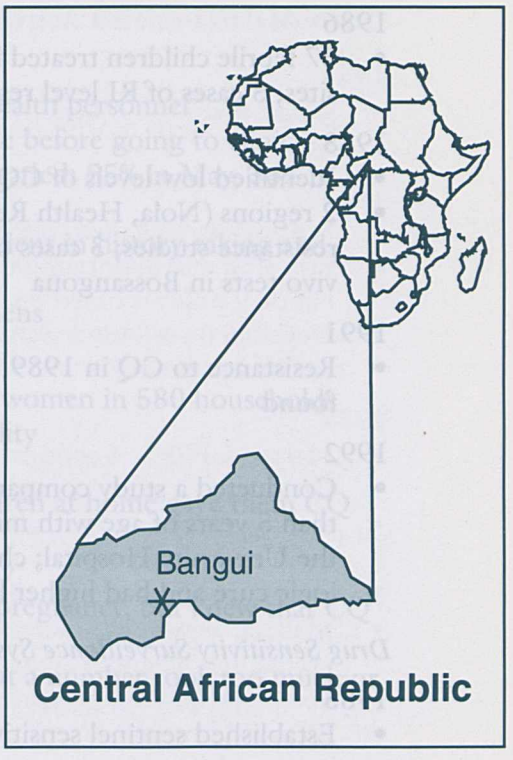
CENTRAL AFRICAN REPUBLIC



Country Data
Population (1991): 3,100,000
% infants with LBW (1990): 15
Infant mortality rate (1991): 106/1000
Under-5 mortality rate (1991): 180/1000
Annual number of under-5 deaths (1991): 25,000
Total fertility rate (1991): 6.2

Years of CCCD Involvement: 1984-1992

National Organization and CDC Resident Staff
National CCCD Program Directors:
Dr. Jean Limbassa, Dr. Jean Baptiste Roungou
National Malaria Coordinators:
Mr. Madji, Dr. Fleurie Mamadou-Yaya,
Dr. Dieudonné Yazipo
Technical Officers:
Dr. Katherine Montgomery, Mr. Joe Naimoli,
Ms. Karen Hawkins Reed
Regional Epidemiologists:
Dr. Melinda Moore, Dr. Ronald Waldman

Major Donors
A.I.D., European Community (EC), Fonds d'Aide et de coopération (FAC), UNICEF, WHO

NOTABLE CCCD ACTIVITIES IN CENTRAL AFRICAN REPUBLIC: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1986
Malaria coordinator named: 1987

Operations Research

Drug Studies (in vivo testing by national or international teams)

1984-1986
See Table 2-1

Table 2-1. Selected Results of In Vivo Testing, 1984-1986

Year	Location	Participants	CQ Dosage	Resistance Level (#)
1984	Bangui	31 asymptomatic schoolchildren	10 mg/kg	RI (1), RII (1)
	Bangui	14 febrile children	25 mg/kg	none
1985	Bangui	29 asymptomatic schoolchildren	10 mg/kg	none
	Bangui	43 febrile children	25 mg/kg	RI (1)
1986	Bouar	25 febrile children	10 mg/kg	RI (1), RII (5)
	Bouar	34 febrile children	25 mg/kg	none

1986
- 57 febrile children treated in Bambari showed low levels of resistance to falciparum parasites; 3 cases of RI level resistance; none had clinical signs by Day 7

1988
- Identified low levels of CQ resistance through local in vivo testing
- 2 regions (Nola, Health Region 2 and Bossangoua, Health Region 3) completed in vivo resistance studies; 3 cases of RI or RII of 63 in vivo tests in Nola; 1 case of RI of 63 in vivo tests in Bossangoua

1991
- Resistance to CQ in 1989, 1990, and 1991 was less than 20%; no cases of RIII were found

1992
- Conducted a study comparing the antimalarial efficacy of CQ and SP in children less than 5 years of age with microscopically confirmed *P. falciparum* at the pediatric unit of the University Hospital; children treated with SP were more likely to achieve parasitologic cure and had higher hemoglobin concentrations than those treated with CQ

Drug Sensitivity Surveillance System (7-day in vivo testing)

1985
- Established sentinel sensitivity surveillance system

1987
- Performed large resistance study using regional in vivo surveillance network

Other Studies

1986

Retrospective study of birth weights outside Bangui
- An average of 18%-24% of all newborns were LBW
- Average newborn weight was 2,837 grams
- Findings called for further study to determine whether malaria was a contributing factor to the high incidence of LBW babies

1988

Conducted retrospective study of hospitalized cases and deaths due to malaria among children less than 15 years of age in the pediatrics complex of the National University Hospital in Bangui
- Malaria CFRs rose from 1987 to 1988
- The number of deaths due to malaria, although small in number, increased from 1987 to 1988

1992

Conducted 2 field surveys of Bangui pharmacists regarding recommended treatment schedules for febrile children
- First survey, prior to the national malaria symposium with physicians and pharmacists, found that none of the recommendations made by pharmacists corresponded to the national malaria policy
- Second survey found that less than half complied with the policy

Conducted a nationwide "willingness to pay" survey
- Vast majority paid for antimalarials in the past and were willing to pay in the future

Knowledge, Attitudes, and Practices (KAP) Surveys

1985

Conducted surveys in Bangui and Bambari of mothers and health personnel

- The majority of mothers cared for febrile children at home before going to clinic
- Proportion of pregnant women using chemoprophylaxis varied: 55% in May, 36% in November
- Health workers generally knew what to do, but were deficient in history-taking and physical examination
- Health workers prescribed a great variety of dosage regimens

1992

Conducted a national survey of febrile children and pregnant women in 580 households

- 20% of mothers took their febrile children to a health facility
- 76% treated the children at home
- A great majority (87%) of mothers who treated their children at home gave them CQ tablets
- Mothers generally started to treat fever during the first day
- Most women did not know the effect of malaria on their pregnancy, but knew that CQ prophylaxis would be helpful
- Most pregnant women took the correct dosage of CQ, but a number took too much or too little

Health Unit Practices Surveys

1986

Evaluated 4 hospitals

- All followed national protocols in the management of malaria cases

1988

Surveyed performance of health personnel in 2 regional hospitals, 1 prefectural hospital, and 8 outpatient facilities

- Found performance in applying the national malaria policy far below minimum levels of acceptable practice
- 1 in 11 facilities used the correct dosage of CQ

Pretested a health facility survey in 11 hospitals and rural health facilities in 2 different regions

- Only one facility recommended treatment according to the dosage protocol
- Most facilities were following guidelines for pregnant women
- About 50% prescribed prophylactic doses for children younger than 5 years of age

1990

Assessed malaria treatment practices among 87 health workers

- Found wide range of performance problems: most facilities had basic supplies, most workers verified the presence of fever and treated with CQ as the drug of choice, but other elements of effective case management were either omitted or performed incorrectly
- Health workers did worse in the areas of health education and promotion of malaria prophylaxis, with generally fewer than half meeting criteria
- Training and health education materials developed to improve patient education

Other Malaria-related Activities

1985

- 4 staff members trained to perform in vivo drug response testing in Zaire during CCCD training

1988

- Sentinel surveillance system established
- Prepared and distributed to health workers appropriate treatment recommendations and national policies based on studies conducted
- Developed preliminary training materials for use in 1989 in-service training program for case management

1989

- Malaria CFRs at 4 sentinel hospitals showed increases: from 3.0 per 100 admissions in 1987, to 4.1 in 1988, and to 7.0 in 1989
- Approximately 31% of children younger than 5 years of age had access to CQ in government and private health centers
- Developed a system for distribution of antimalarials
- Malaria, as well as other CCCD target diseases, reported monthly from 15 regional and prefectural hospitals (sentinel sites)
- Feedback bulletin first published
- National hospital surveillance system established and case definitions approved for reportable diseases

1990

- Malaria CFR of 5% seen in 15 regional and prefectural hospitals in the sentinel system
- Health information system (HIS)–generated data on in vivo response to antimalarials contributed to the development of national malaria treatment policy
- Produced training manual on malaria prevention and treatment, which was based on results of health worker practice evaluation
- 3 issues of *The DMPGE* (Departement de Médecine Preventive et Grandes Endémies) *Echo*, an epidemiology newsletter, published and distributed to program managers and health workers

1991

- Developed a malaria training manual for 1991 training programs; refined in 1992
- Trained over 500 health agents in the proper case management of malaria among febrile children and malaria prevention among pregnant women

1992

- Participated in a regional workshop on the revision and refinement of the national malaria policy; after the workshop, refined national malaria policy addressing the proper case management of fever and malaria; policy then signed by the Minister of Health
- Conducted a national symposium to communicate to approximately 200 physicians and pharmacists the national policy on recommended treatment protocol for malaria, including proper case management and prevention for pregnant women
- Participated in a regional workshop on the development of national malaria control programs
- Refined national program after the workshop

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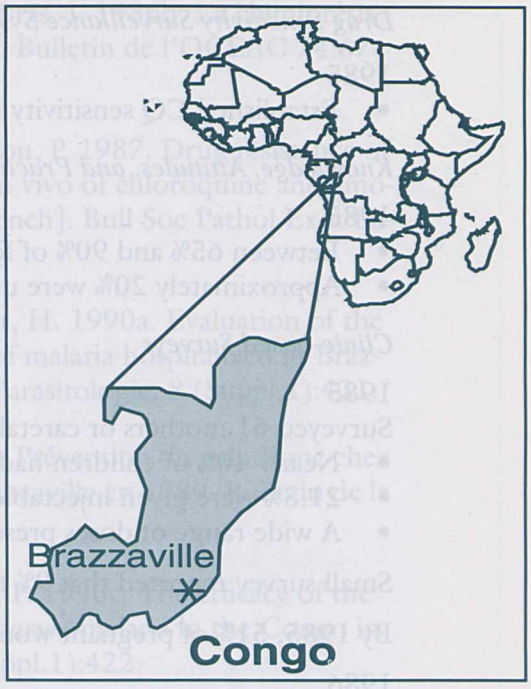
CONGO



Country Data
Population (1991): 2,300,000
% infants with LBW (1990): 16
Infant mortality rate (1991): 83/1000
Under-5 mortality rate (1991): 110/1000
Annual number of under-5 deaths (1991): 11,000
Total fertility rate (1991): 6.3

Years of CCCD Involvement: 1984-1987

National Organization and CDC Resident Staff
National CCCD Program Director:
Dr. Gabriel Madzou
National Malaria Coordinators:
Mr. Henri Moudzeo, Dr. Gaston Samba
Technical Officers:
Dr. Pierre Eozenou (FAC), Mr. Brian Fitzgibbon, Ms. Karen Hawkins Reed
Regional Epidemiologists:
Dr. Melinda Moore, Dr. William Taylor

Major Donors
A.I.D., FAC, UNICEF

NOTABLE CCCD ACTIVITIES IN CONGO: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1986
Malaria coordinator named: 1985

Operations Research

Drug Studies

1985-1986
See Table 2-2

Table 2-2. Results of In Vivo Testing, 1985-1986

Year	Location	Drug resistance (%)		
		10 mg/kg CQ	25 mg/kg CQ	25 mg/kg AQ*
1985	Linzolo	20.0	n.t.†	n.t.
	Brazzaville	59.1	40.0	26.3
	Mayombe	74.1	28.8	n.t.
	Chaillu	57.1	38.7	n.t.
1986	Brazzaville	n.t.	38.7	21.2

* AQ = Amodiaquine
† n.t. = Not tested

Drug Sensitivity Surveillance System (7-day in vivo testing)

1985
- Established CQ sensitivity monitoring surveillance system

Knowledge, Attitudes, and Practices (KAP) Surveys

1985
- Between 65% and 90% of febrile children received CQ
- Approximately 20% were underdosed

Clinic-based Surveys

1985
Surveyed 61 mothers or caretakers in Brazzaville
- Nearly 40% of children had received some treatment before coming to clinic
- 21.3% were given injectable quinine
- A wide range of doses prescribed, but all were within therapeutic limits

Small survey reported that 9% to 20% of malaria cases in children treated correctly

By 1985, 51% of pregnant women received regular prophylaxis

1986
- By this time, 100% of hospitals and health centers were using malaria treatment and prophylaxis protocol

Other Malaria-related Activities

1985
- 4 staff members taught in vivo drug response testing in Zaire to monitor resistance levels; they helped establish national drug sensitivity testing network
- Trained regional health workers using model CCCD training guides and WHO training materials; regional teams developed action plans for malaria activities, as well as other CCCD interventions

1986
- 3rd CCCD Consultative Meeting held in Brazzaville, followed by CDC-sponsored 2-day workshop on drug testing

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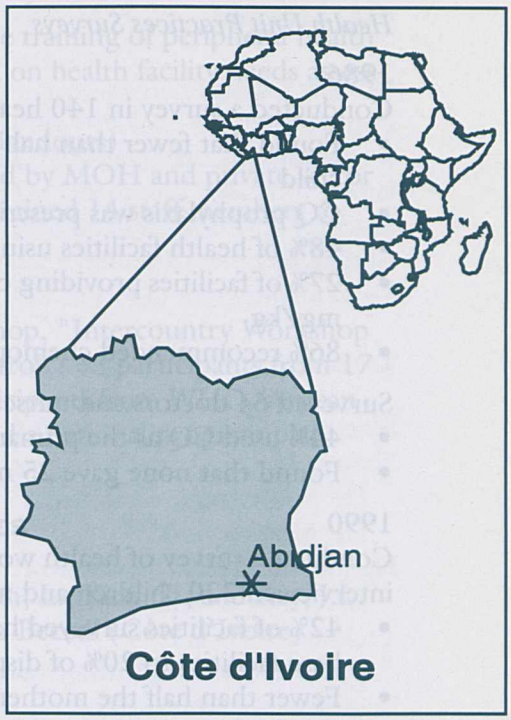
COTE D'IVOIRE



Country Data
Population (1991): 12,500,000
% infants with LBW (1990): 14 (Abidjan only)
Infant mortality rate (1991): 93/1000
Under-5 mortality rate (1991): 127/1000
Annual number of under-5 deaths (1991): 77,000
Total fertility rate (1991): 7.4

Years of CCCD Involvement: 1985-1992

National Organization and CDC Resident Staff
National CCCD Program Directors:
Mr. L. Bla Toh, Dr. Estelle Shaw
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Dr. Amananman, Dr. Guy Imbua-Bogui,
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Major Donors
A.I.D., FAC, International Development Research Center (IDRC), Overseas Development Agency (ODA), UNICEF

NOTABLE CCCD ACTIVITIES IN COTE D'IVOIRE: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1986
Malaria coordinator named: 1985

Operations Research

Drug Studies (in vivo testing by national or international teams)

1986
Conducted a study of 109 children 6 months to 5 years of age in 2 rural areas (Adzopé and Bouaflé)

- *P. falciparum* sensitive to 10 mg/kg of CQ

Conducted a study of 96 children 5 to 15 years old near Abidjan

- 10 mg/kg of CQ effective, as was 200 mg of amodiaquine (AQ)

Drug Sensitivity Surveillance System (7-day in vivo testing)

1987

- Periodic sensitivity studies undertaken by the National Public Health Institute

Health Unit Practices Surveys

1986

Conducted a survey in 140 health facilities

- Found that fewer than half (48%) prescribed the correct dose of CQ for a 2-year-old child
- CQ prophylaxis was prescribed for pregnant women by 9 of 28 practitioners
- 48% of health facilities using CQ provided an acceptable dose
- 27% of facilities providing chemoprophylaxis used the WHO-recommended dose of 300 mg/kg
- 86% recommended chemoprophylaxis to pregnant women

Surveyed 64 doctors and nurses in Abidjan

- 44% used CQ as the primary treatment drug
- Found that none gave 25 mg/kg of CQ

1990

Conducted survey of health worker performance and logistics support at 41 health facilities; interviewed 320 children and mothers; survey provided basis for planning training activities

- 42% of facilities surveyed had CQ in syrup or tablet form in stock, ranging from 75% of base facilities to 20% of dispensaries
- Fewer than half the mothers of children diagnosed with fever were told when they should return with the child; 60% of health workers explained the administration of CQ to mothers; only 1 in 10 told the importance of completing the treatment course
- Of the 86 diagnosed febrile children, 83% of mothers received a prescription for an anti-malarial

1991

Trained health personnel in the 41 facilities surveyed in 1990 and evaluated the training

- Observed an increase in education about how to administer medicines and about the need for 3 days of treatment

Other Malaria-related Activities

1986

- Held seminar on drug sensitivity testing for participants from Côte d'Ivoire, Guinea, Burundi, and the Organisation de Coopération et de Coordination pour la lutte contre les Grandes Endémies

1988

- Yamoussoukro site of fourth CCCD consultative meeting, March 1988

1989-90

- National disease reporting system operational; data generated from drug sensitivity testing used to contribute to national malaria treatment strategies
- Developed and distributed 2 versions of malaria treatment poster that emphasized use of CQ in dosage of 25 mg/kg over 3 days

1990

- Sentinel surveillance project implemented in 5 geoclimatically representative sites

1990-91

- Developed training model to achieve systematic in-service training of peripheral health workers by district staff members; training strategy based on health facility needs assessments; 8 of the 26 health districts held peripheral courses
- Developed and field-tested training materials (technical handouts)
- Printed and distributed malaria treatment chart developed by MOH and private sector
- Provided 10 microscopes to 5 urban health centers and trained 14 staff members to examine thick and thin blood smears

1992

- As part of Malaria Control Initiative, held 10-day workshop, "Intercountry Workshop on Program Planning and Management for Malaria Control"; 35 participants from 17 francophone African countries attended, along with participants from WHO/African Regional Office and WHO/Geneva; each country drafted a national program plan

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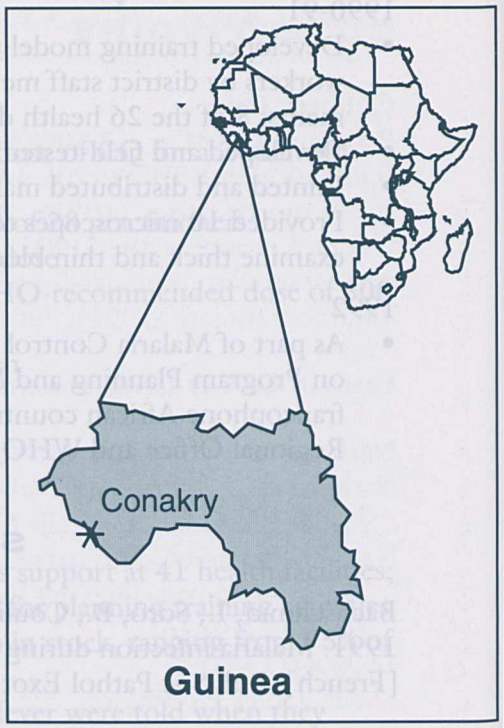
GUINEA



Country Data
Population (1991): 5,900,000
% infants with LBW (1990): 21
Infant mortality rate (1991): 138/1000
Under-5 mortality rate (1991): 234/1000
Annual number of under-5 deaths (1991): 71,000
Total fertility rate (1991): 7.0

Years of CCCD Involvement: 1985-1991

National Organization and CDC Resident Staff
National CCCD Program Directors:
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National Malaria Coordinator:
Dr. Moussa Keita
Technical Officers:
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Regional Epidemiologist:
Dr. Alain Roisin

Major Donors
A.I.D., UNICEF, World Bank

NOTABLE CCCD ACTIVITIES IN GUINEA: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1988
Malaria coordinator named: Prior to CCCD

Operations Research

Drug Studies (in vivo testing by national or international teams)

1989
Carried out first in vivo studies of antimalarial resistance with assistance from CCCD/Zaire
- Failed to document evidence of CQ resistance in Kindia
- Showed that 67% of the 766 children examined were slide positive for malaria

1990
Conducted a study in Conakry of 39 children who were treated with 25 mg/kg of CQ over 3 days
- Dosage was effective; children were free of parasites at day 7

Conducted a study in Conakry of 923 children
Testing without outside help confirmed lack of CQ resistance
- Found that half were slide positive for malaria
- With treatment, children had no parasites at day 7

Other studies

1986

Assessed effect of malaria control measures on parasitemia during pregnancy among 948 pregnant women in Conakry

- None of the women taking an antimalarial were parasitemic; 7% of those who did not take an antimalarial were parasitemic
- No correlation was found between recent history of fever and parasitemia

Knowledge, Attitudes, and Practices (KAP) Surveys

1985

Conducted a study of treatment of fever in 2 prefectures

- In Dinguiraye Prefecture, 6% of febrile children were seen at a health center; 13% were treated with an antimalarial drug at home
- In northern Dabola Prefecture, 17% of febrile children were seen at a health center; 21% received treatment with an antimalarial at home

1988

Conducted a community survey in Kindia and Telimélé of 243 mothers in rural and urban areas

- 39% of urban and 22% of rural women took CQ during their most recent pregnancy
- Use of drugs related to access and availability factors, including perceived nearness of health facility, perceived use of CQ by others, and affordability of drugs
- Documented differences in CQ use for fever in urban vs rural areas: 67% in urban areas treated fever with CQ, and 40% in rural areas used CQ for fever

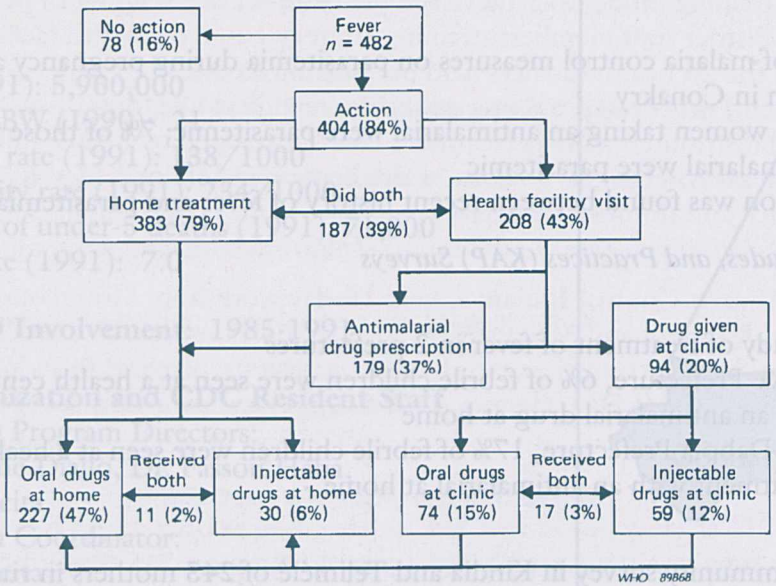
Health Unit Practices Surveys

1986

Health practices survey methodology developed and field tested in Conakry; assessed health practices of 1,415 caretakers and their 2,048 children (Fig. 2-2)

- In 20% of cases the caretaker ascribed the fever to malaria
- 43% of febrile children were taken to a health worker
- Nearly three-fourths (74%) of children taken to health worker within 48 hours of fever onset
- Use of injectable antimalarials and prolonged treatment with CQ were common at health facilities
- 79% of febrile children were treated at home

Figure 2-2. Treatment Scheme for Children with Fever, Conakry, 1986



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1988

Health center needs assessment conducted in Conakry by direct observation of health workers' management of febrile children

- Nearly all (98%) febrile children weighed
- 73% given an antimalarial
- 16% given the correct dose of antimalarial

1989-90

Assessed health worker practices in rural areas of Telimélé prefecture

- Approximately half of febrile children weighed
- Approximately 80% of cases prescribed CQ

1990

Conducted a record review of Conakry health care centers

- With a national policy prescribing 25 mg/kg during 3 days, physicians continued to prescribe a number of drugs, including injectable quinine
- 80% of fever cases treated with appropriate therapy

Other Malaria-related Activities

1986

- CCCD/Guinea malaria program staff members trained to conduct in vivo testing during Côte d'Ivoire study and training exercise

1987

- Developed monthly case reporting forms and CQ inventory forms

1988

- Training needs assessments identified specific needs for training in malaria; health education materials (3 posters) developed to strengthen patient education

- 20 malaria control technicians participated in training course in malaria slide microscopy and in vivo drug sensitivity testing

1989

- Health educators and social scientists trained to use formative research methods, including ethnography, to plan health education programs dealing with presumptive treatment of children <5 years of age and chemoprophylaxis for pregnant women
- Zairians trained by CDC in in vivo testing provided training and expert consultation to Guinea
- Established a distribution system for CQ, including inventory, distribution, reporting, and financial accountability
- Established sentinel surveillance system
- Instituted cost recovery system in Kindia and Telimélé; revenues from sale of CQ tablets used for local recurrent costs

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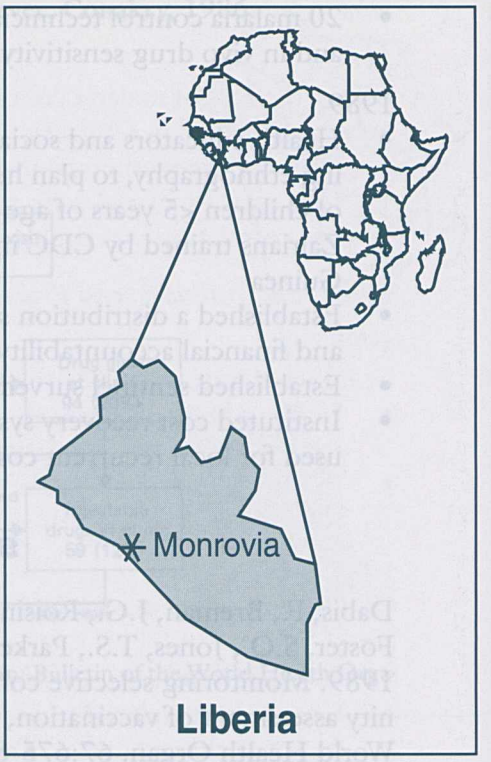
LIBERIA



Country Data
Population (1991): 2,700,000
% infants with LBW: data not available
Infant mortality rate (1991): 131/1000
Under-5 mortality rate (1991): 200/1000
Annual number of under-5 deaths (1991): 25,000
Total fertility rate (1991): 6.8

Years of CCCD Involvement: 1983-1990

National Organization and CDC Resident Staff
National CCCD Program Directors:
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National Malaria Directors:
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Technical Officers:
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Major Donors
A.I.D., Christian Health Association of Liberia, Peace Corps, Plan International, Rotary International, South Eastern Regional Primary Health Care Project, UNICEF, WHO

NOTABLE CCCD ACTIVITIES IN LIBERIA: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1987
Malaria coordinator named: 1985

Operations Research

Drug Studies (testing by national or international teams)

1988
- CQ-resistant malaria documented in Zorzor, Lofa County
- Documented low rates of *P. falciparum* parasitemia among 400 children in Monrovia area
- In vitro studies at Elwa Hospital confirmed CQ resistance

Demographic and Health Survey (DHS)

1986
- Over half (51%) of 4,224 children less than 5 years of age had one or more episodes of fever in the month preceding the survey
- 74% of childhood fever cases treated with antimalarials
- Prevalence of fever highest (67%) among children aged 12-17 months

Health Unit Practices Surveys

1986

Reviewed practices in 11 health facilities

- More than 80% were using a treatment regimen consistent with the new policy
- Approximately 70% were providing prophylaxis to pregnant women

1989

Assessed health worker performance, including communication practices of health workers, at 45 facilities in 6 counties

- Excessive use of injections for malaria treatment identified as performance problem (nearly half of health workers gave an initial injection with CQ)
- Although most health workers reportedly advised mothers to give CQ for 3 days, exit interviews of mothers showed a lack of understanding
- CQ treatment charts available in only 3 of 10 clinics; SP, second-line drug, available in only 3 of 45 facilities
- Malaria supplies in stock in 45 facilities; CQ tablets in over 90%; CQ syrup in over 80%

1990

- Conducted survey of malaria treatment practices among pharmacists and medicine store dispensers; because of civil war, CCCD staff evacuated before data entered and analyzed

Mortality and Use of Health Services Surveys (MUHS)

1984-85

- Conducted MUHS surveys and reinterview surveys

1988

Repeated MUHS surveys

- Showed 14.5% decrease in under-5 mortality
- Little change found in home treatment for malaria/febrile illness (69% in 1984; 67% in 1988)
- Showed 80% of febrile children, more than half of whom were treated at home, given "Western" medicine
- Approximately 7 in 10 febrile children less than 5 years of age received an antimalarial in 1984 and 1988
- The proportion of febrile children who visited a clinic or a hospital fell from 41% in 1984 to 24% in 1988
- Home treatment with CQ increased from 4.5% in 1984 to 35% in 1988

Other Malaria-related Activities

1987

- First quarterly newsletter produced and distributed
- Trained 4 national staff in methodology of in vivo monitoring of CQ resistance

1987-88

- Radio messages, songs, and dramas on malaria modified and produced

1988

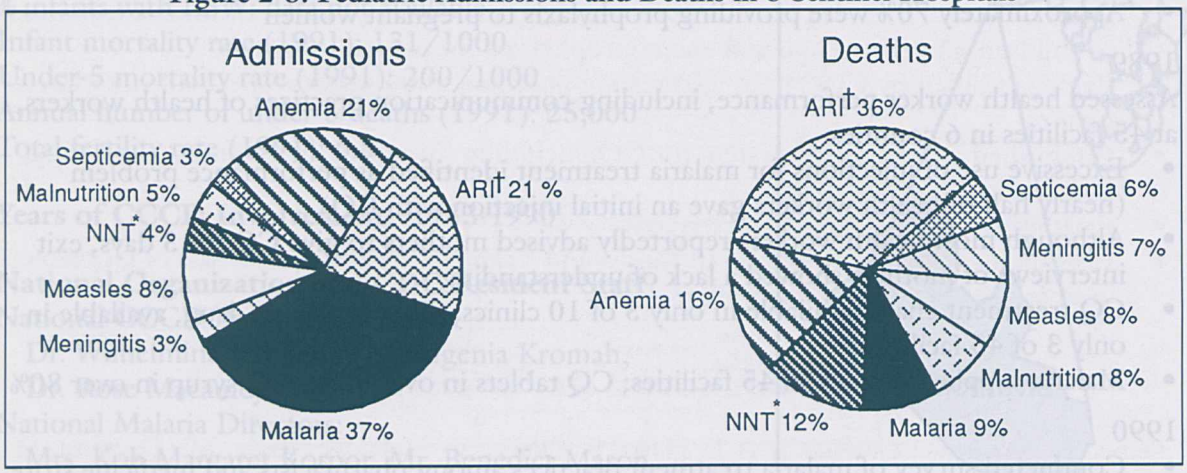
- 4 Liberians trained in Nigeria to perform in vivo testing for *P. falciparum* drug resistance

1988-89

- Malaria treatment poster developed and tested

- Computerized hospital sentinel surveillance system established in 5 hospitals; data collected on pediatric morbidity and mortality (Fig. 2-3)

Figure 2-3. Pediatric Admissions and Deaths in 5 Sentinel Hospitals



*NNT = Neonatal tetanus
†ARI= Acute respiratory infection

- Developed prototype of computerized hospital morbidity reporting system

1989

- Participated in WHO Intercountry Workshop on Regional Malaria Control Strategies for Primary Health Care in Monrovia; developed draft protocol for diagnosis and clinical management of malaria at community, clinic, and hospital levels
- Revised malaria training modules and health education materials

1989-90

- Malaria standard 3-day CQ (tablets and syrup) treatment charts revised and field-tested
- Sentinel disease surveillance system established at 6 hospitals

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MALAWI

Country Data
Population (1991): 9,900,000
% infants with LBW (1990): 20
Infant mortality rate (1991): 144/1000
Under-5 mortality (1991): 228/1000
Annual number of under-5 deaths (1991): 123,000
Total fertility rate (1991): 7.6

Years of CCCD Involvement: 1984-1987
Limited scope grant agreement: 1988-90
Atlanta-based CCCD support: 1990-93

National Organization and CDC Resident Staff
National CCCD Program Managers:
Dr. Jean Kalilani, Mr. Geoffrey Lungu,
Dr. Alice Msachi
National Malaria Coordinators:
Mr. Alan Macheso, Dr. Jack Wirima
Technical Officer:
Mr. Reginald Hawkins
Field Epidemiologist:
Dr. David Heymann

Major Donors
A.I.D., EC, ODA, UNICEF, World Bank

NOTABLE CCCD ACTIVITIES IN MALAWI: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1985
Malaria coordinator named: 1984

Operations Research

Drug Studies (in vivo testing by national or international teams)

1984
Conducted a study among 246 children less than 5 years of age to test the success of 25 mg/kg CQ

- Dosing regimen successful in clearing symptoms
- 90% of children responded clinically within 7 days, but 60% continued to have low-grade parasitemia on day 7
- Country adopted this regimen as primary therapy for malaria

Studied the efficacy of AQ, SP, and CQ among 152 children less than 5 years of age in Lilongwe

- AQ and SP superior to CQ in clearing parasites promptly
- SP superior to AQ in keeping children free of parasites

1985
Evaluated response of 94 children in Lilongwe to 25 mg/kg of CQ; clinical success or failure defined by "illness" index scores
- By day 7, 73% were clinical successes
- By day 14, 46% of those followed remained clinically improved

1985-86
Conducted a study of febrile children given CQ at outpatient health facilities in 2 sites
- Found clinical signs and symptoms associated with parasite density; at both sites, axillary temperature ≥37.3°C was associated with parasite density; at another, history of fever in the preceding 48 hours, reduced appetite, and reduced fluid intake were also associated with parasite density

1986
A study of 25 children in Lilongwe showed that quinine remained effective in controlling parasitemia in a setting of CQ resistance

1987
Studied the efficacy of halofantrine among 49 children less than 5 years of age in towns on the west coast of Lake Malawi
- Halofantrine found effective against *P. falciparum* parasites sensitive and resistant to CQ
- Malaria treated with a single dose of halofantrine (16 mg/kg) showed a high recrudescence rate on day 14 (38%)
- The cure rate was 96% with a 3-dose schedule of 8 mg/kg

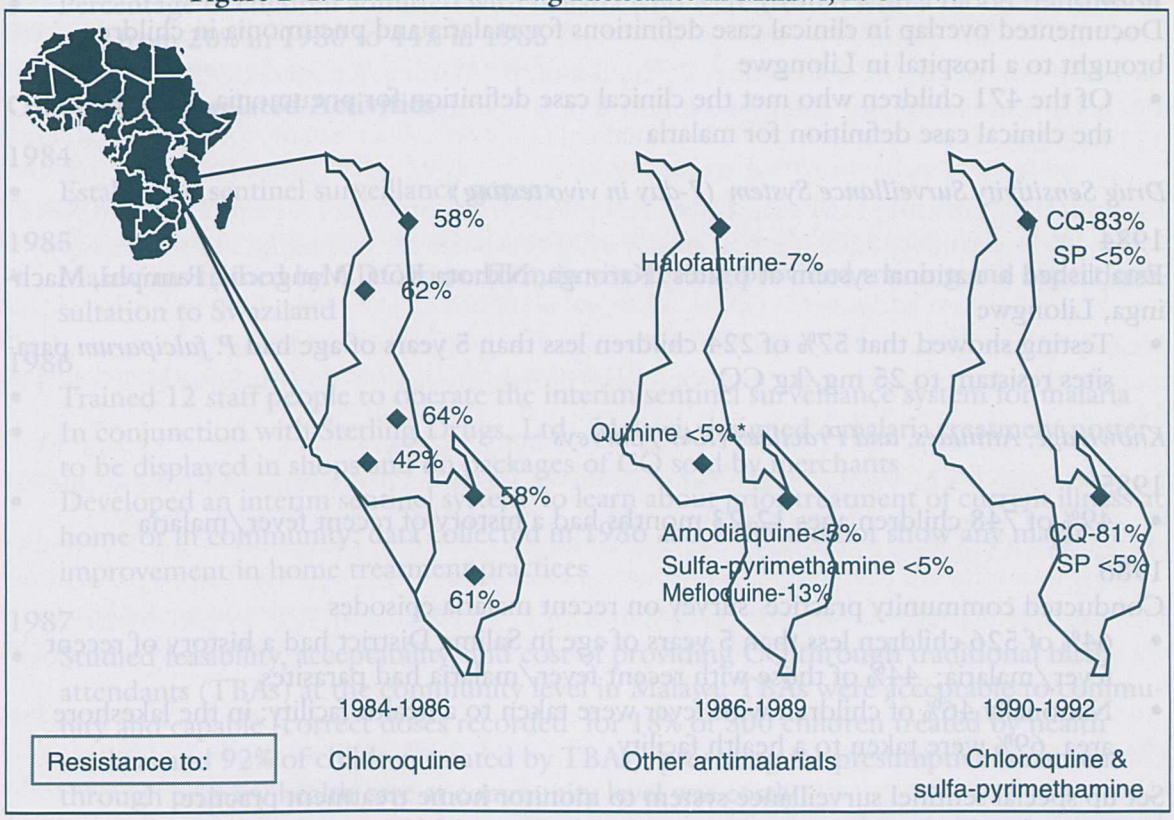
1988
Among 121 children less than 5 years of age in Mangochi, mefloquine (MQ) proved to be an effective therapy, but therapy was complicated by frequent vomiting

1990
Assessed the clinical, parasitologic, and hematologic responses of 153 young children to CQ and SP
- Children treated with SP maintained clinical improvement and had greater increases in their hemoglobin concentration than did those treated with CQ
- Concluded that CQ should no longer be considered adequate to treat clinical falciparum malaria in very young children in these areas of Africa

Found that cotrimoxazole may treat effectively both febrile illness and acute lower respiratory tract infection in young children in malaria-endemic areas

1991
Investigated the efficacy of CQ and SP among pediatric patients less than 3 years of age in Mangochi
- A high level of CQ resistance (81% RII and RIII) was seen among children treated with CQ
- SP was better than CQ in increasing time to clinical failure and level of hematologic recovery

Figure 2-4. Antimalarial Drug Resistance in Malawi, 1984-1992



*Confidence intervals of the resistance estimates allow for determination of approximately <5%.

Other Studies

1986

- Showed that weekly chemoprophylaxis among 83 pregnant women in Lilongwe with CQ or AQ reduced density of infection and rates of placental infection, but did not prevent infection

1988

Parasitemia rapidly and spontaneously cleared from peripheral circulation of pregnant women after delivery

- Of the 43 pregnant women in Mangochi, 95% of the women followed for 48 hours after delivery became free of parasites

Conducted a cost-effectiveness study of CQ among 642 pregnant women in sites of year-round and seasonal transmission

- Chloroquine-resistant *Plasmodium falciparum* and poor compliance levels limited the protective efficacy to 8% for a program of antenatal chemoprophylaxis with a prophylactic dose of CQ (300 mg)
- The cost for preventing one infection was unacceptably high

1987-90

Conducted Mangochi Malaria Research Project

- Documented that women in their first or second pregnancies were at greatest risk of malaria-associated LBW
- Mefloquine in prophylactic doses reduced the incidence of placental infection, which is associated with LBW

1990

Documented overlap in clinical case definitions for malaria and pneumonia in children brought to a hospital in Lilongwe

- Of the 471 children who met the clinical case definition for pneumonia, 95% also met the clinical case definition for malaria

Drug Sensitivity Surveillance System (7-day in vivo testing)

1984

Established a national system at 6 sites (Karonga, Nkhota Kota, Mangochi, Rumphi, Machinga, Lilongwe)

- Testing showed that 57% of 224 children less than 5 years of age had *P. falciparum* parasites resistant to 25 mg/kg CQ

Knowledge, Attitudes, and Practices (KAP) Surveys

1985

- 49% of 748 children ages 12-23 months had a history of recent fever/malaria

1986

Conducted community practice survey on recent malaria episodes

- 64% of 526 children less than 5 years of age in Salima District had a history of recent fever/malaria; 44% of those with recent fever/malaria had parasites
- Nationally 46% of children with fever were taken to a health facility; in the lakeshore area, 69% were taken to a health facility

Set up special sentinel surveillance system to monitor home treatment practice

- 15% of all febrile children were treated with CQ and 18% given an antipyretic

1992

Conducted a national community practices survey of 1,531 households

- 88% of febrile children less than 5 years of age received an antimalarial within 48 hours of onset of fever
- One-quarter of children less than 5 years of age received the correct dose of an antimalarial
- 93% of recently pregnant women attended an antenatal clinic at least once during their pregnancies
- Total cost of malaria prevention and treatment was 7% of household income

Health Unit Practices Surveys

1986

Job performance survey conducted of 86 health workers who had received a refresher course for presumptive treatment 1 year before

- Fewer than one-quarter prescribed correct amount of CQ for age or gave an antipyretic
- Over half (52%) took child's temperature
- 90% prescribed CQ
- 91% of mothers not told what to do for child with fever

Reviewed 8,454 records at one sentinel site for all pediatric admissions from 1980 to 1986

- Showed a decrease in the percentage of children treated with parenteral CQ from 54% in 1980 to 6% in 1986, and a concurrent increase in quinine from fewer than 1% of children in 1980 to 24% in 1986
- The use of oral CQ increased from 45% of all malaria admissions in 1980 to 78% in 1986

- Percentage of children admitted with malaria who were treated with a blood transfusion rose from 20% in 1980 to 44% in 1985

Other Malaria-related Activities

1984
- Established sentinel surveillance system

1985
- Malawians trained by CDC to perform in vivo testing provided training and expert consultation to Swaziland

1986
- Trained 12 staff people to operate the interim sentinel surveillance system for malaria
- In conjunction with Sterling Drugs, Ltd., Malawi, designed a malaria treatment poster to be displayed in shops and on packages of CQ sold by merchants
- Developed an interim sentinel system to learn about prior treatment of current illness at home or in community; data collected in 1986 and 1987 did not show any major improvement in home treatment practices

1987
- Studied feasibility, acceptability, and cost of providing CQ through traditional birth attendants (TBAs) at the community level in Malawi: TBAs were acceptable to community and capable (correct doses recorded for 18% of 300 children treated by health workers and 92% of children treated by TBAs); providing for presumptive treatment through primary health care at community level was costly

1988

Conducted a cost-effectiveness analysis of health education messages in conjunction with different antimalarials designed to increase compliance among pregnant women
- Found that the addition of a new nonbitter medication was the most cost-effective means of improving compliance; use of CQ supplemented by a new health education message ranked second

1989
- Review of 1985-1989 5-year plan documented lack of progress in reduction of cases of malaria and reduction of death due to malaria; recommendations for a revision of strategies and implementation were made
- The 1990-1994 5-year Plan for Malaria Control was drafted, modified, and approved; and elements to improve malaria control efforts were highlighted: improved awareness and compliance in the general population; better diagnosis; nationwide treatment; prevention activities; alternative methods of control; improved knowledge of health care workers; strengthened reporting, management, and human resource management; and increased government and donor support

1991
- Revised national guidelines for malaria treatment

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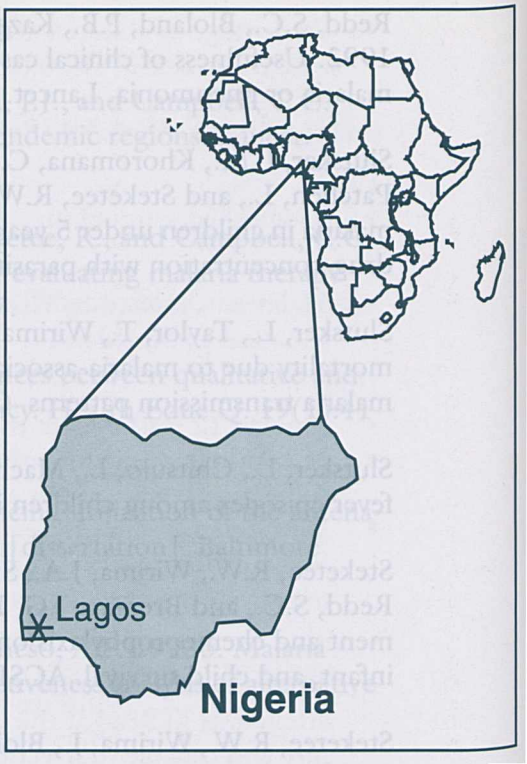
NIGERIA



Country Data
Population (1991): 88,500,000
% infants with LBW (1990): 16
Infant mortality rate (1991): 86/1000
Under-5 mortality rate (1991): 188/1000
Annual number of under-5 deaths (1991): 1,008,000
Total fertility rate (1991): 6.6

Years of CCCD Involvement: 1986-1993
Nationwide: 1986-1989
Focus Local Government Authorities (9 states, 12 Local government areas [LGA], and 4 federal focus agencies): 1990-1993

National Organization and CDC Resident Staff
National CCCD Program Director:
Dr. A.O.O. Sorungbe
National Malaria Coordinator:
Dr. O.J. Ekanem
Technical Officers:
Mr. James Herrington, Mr. Warren Jones, Dr. Barbara Maciak, Mr. John Nelson
Epidemiologists:
Dr. Rick Spiegel, Dr. Jason Weisfeld

Major Donors
A.I.D., IDRC, Japanese Technical Assistance, ODA, Rotary International, UNICEF, WHO

NOTABLE CCCD ACTIVITIES IN NIGERIA: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1989
Malaria coordinator named: Prior to CCCD

Operations Research

1987

- Nigerian Research Review Committee set up to approve operations research proposals

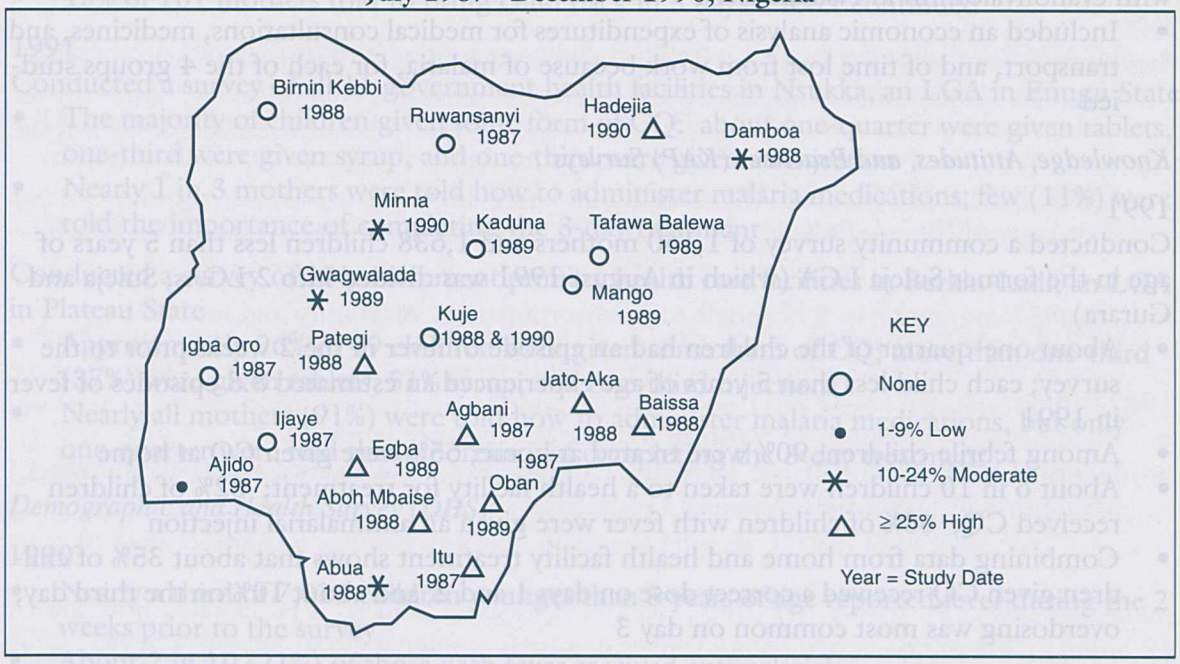
1991

- At end of 1991, 85 protocols submitted, 36 (12 of which were malaria) approved, and 13 completed

Drug Studies (in vivo testing by national or international teams)

- Resistance to both CQ (Fig. 2-5) and SP spread from the Southeast and became more severe

Figure 2-5. Level of Early and Late Parasitologic Failures to Chloroquine Therapy, Children Less than 5 Years of Age, National Malaria Surveillance Network, July 1987– December 1990, Nigeria



National Malaria Surveillance Network (14-day in vivo testing)

1987

- Antimalarial drug sensitivity network established involving 4 universities (Calabar, Ibadan, Maiduguri, Zaria) and the Federal MOH (FMOH)

Other Studies

1988

Conducted a pilot project to provide background information on the slide positivity rates on the Jos Plateau and to assess attitudes toward the use of bed nets

- Of the 1,617 children less than 18 years of age examined, the mean slide positivity rate was 32% over 2 seasons
- Attitudes toward bed-net use favorable in Amo Katako
- Impregnated bed nets not used adequately in the homes where they were installed for 5 weeks

Conducted in vivo and in vitro studies of the efficacy of pyrimethamine for suppressive or causal prophylaxis among pregnant women in Ilorin

- 67% of in vivo tests and 60% of in vitro tests showed pyrimethamine resistance when given as suppressive prophylaxis
- A study group given pyrimethamine as causal prophylaxis had no fewer parasitologic failures than the control group; thus, pyrimethamine was not effective as causal prophylaxis

1991

- Conducted a study of drug quality control for antimalarials and antibiotics; sampled at all levels of the drug supply system; drug assays done at Nigerian Government Drug Testing Facility; data not yet available

1992
Began 2-year study of permethrin-impregnated bed nets, curtains, and residual wall spray with cyanohyalothrin in Nsukka LGA

- Included an economic analysis of expenditures for medical consultations, medicines, and transport, and of time lost from work because of malaria, for each of the 4 groups studied

Knowledge, Attitudes, and Practices (KAP) Surveys

1991
Conducted a community survey of 1,160 mothers and 1,638 children less than 5 years of age in the former Suleja LGA (which in August 1991 was divided into 2 LGAs, Suleja and Gurara)

- About one-quarter of the children had an episode of fever in the 2 weeks prior to the survey; each child less than 5 years of age experienced an estimated 8.8 episodes of fever in 1991
- Among febrile children, 90% were treated at home; 65% were given CQ at home
- About 6 in 10 children were taken to a health facility for treatment; 82% of children received CQ; 68% of children with fever were given an antimalarial injection
- Combining data from home and health facility treatment shows that about 35% of children given CQ received a correct dose on days 1 and 2, and about 10% on the third day; overdosing was most common on day 3

1992
Conducted a community survey of 1,160 mothers and 1,605 children younger than 5 years of age in Barkin-Ladi, an LGA in Plateau State

- Almost one-third of the children less than 5 years of age (31.5%) had an episode of fever in the 2 weeks prior to the survey; each child was estimated to experience 6.6 episodes of fever per year
- Among febrile children, 54% were treated with medicine at home; 27% were given CQ (the only antimalarial given by mothers in this survey) at home
- Of all febrile children, nearly half (46%) were taken to a health facility; 84% of those treated at a health facility were given CQ; about one third (32%) received an antimalarial injection
- Data from home and facility treatment show that about 35% of children who were given CQ received correct doses on days 1 and 2, and about 10% on the third day, when overdosing was common; this pattern held true regardless of where the children received treatment

Health Unit Practices Surveys

1988
Assessed quality of health worker delivery of care in 30 health facilities in Niger State

- Calculation of CQ dosage rarely based on age or weight
- CQ in some form given to 98% of 56 children seeking treatment for fever, 54% as injections
- Correct oral dosage given to 82% of children younger than 12 months of age; correct oral dosage given to 8% of children older than 12 months

1989
Previous study repeated in 27 health facilities

- In 101 observations, 98% prescribed antimalarial; 45% received correct dose

- 62% prescribed injection and syrup, 2% injection only, 7% injection and tablet
- 10% of facilities had no CQ tablets or syrup
- 15% of 101 mothers told to bring child back in 3 days if fever continued

1991

Conducted a survey of all 11 government health facilities in Nsukka, an LGA in Enugu State

- The majority of children given some form of CQ: about one-quarter were given tablets, one-third were given syrup, and one-third were given an injection
- Nearly 1 in 3 mothers were told how to administer malaria medications; few (11%) were told the importance of completing the 3-day treatment

Conducted a survey of 13 government primary health care facilities in Barkin-Ladi, an LGA in Plateau State

- Approximately 96% of 49 children were given some form of CQ; more than one-third (37%) were given tablets, 51% syrup, and one-third injections
- Nearly all mothers (91%) were told how to administer malaria medications, but only one-quarter were told the importance of completing the 3-day treatment

Demographic and Health Survey (DHS)

1990

- Nearly a third of 7,028 children younger than 5 years of age reported fever during the 2 weeks prior to the survey
- About 2 in 10 (21%) of those with fever received antimalarials
- Children of urban mothers and more well-educated mothers were more likely to be taken to a health facility for treatment of their fever
- 30% were taken to a health facility or provider

Other Malaria-related Activities

1988-89

- Sentinel surveillance at University College Hospital in Ibadan documented an increase in the percentage of outpatient department consultations diagnosed as malaria

1989-90

- Operational research study documented substandard low potency CQ syrup in about one-third of commercially acquired samples in eastern Nigeria
- Malaria sentinel surveillance continued at selected health facilities
- Instituted expanded use of microscopy
- Malaria training module developed to be incorporated into the training program, pre-tested in Niger State, and approved for use throughout country

1990

- Primary Health Care (PHC) sentinel surveillance system designed

1990-91

- 4th Annual Health Education Management Workshop conducted by African Regional Health Education Center (ARHEC), University of North Carolina, and International Health Program Office, CDC: Health Education for Malaria Control in the Context of a Primary Health Care Approach
- The College of Medical Sciences, University of Calabar, in collaboration with FMOH, organized and held the International Workshop on the Current Treatment and Prevention of Malaria at the University of Calabar; 7 countries represented and 11 Nigerian universities participated

- Computers installed and staff trained in all 4 zonal PHC offices and 9 sentinel hospitals
- Computerized system established and integrated into the national PHC system

1991

- LGA Malaria Initiative begun, a multidisciplinary approach to incorporate a variety of program components: training, health education, logistics, health information systems, and operational research; 4 LGAs (Barkin-Ladi, Suleja, Ife-Central, Nsukka) selected for intensification of malaria control activities during 1991-1993; a joint collaboration by FMOH, State MOH, LGA Department, and CCCD
- First issue of *Nigeria Bulletin of Epidemiology* published; 3 issues published in 1991

1992

- Installed computers in 8 hospitals to monitor inpatient morbidity and mortality
- 3 issues of *Nigeria Bulletin of Epidemiology* published

1987-1993

- Held biannual meetings of National Malaria Surveillance Network
- National Malaria Surveillance Network, composed of 4 universities and the Federal MOH, monitored drug sensitivity

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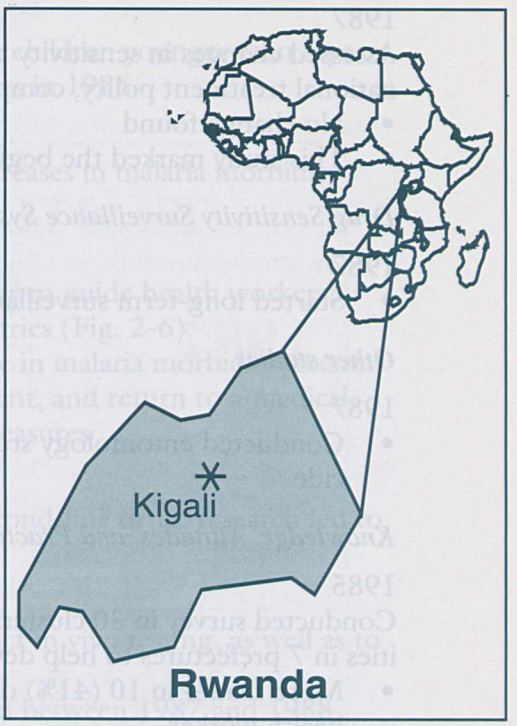
RWANDA



Country Data
Population (1991): 7,300,000
% infants with LBW (1990) : 17
Infant mortality rate (1991): 112/1000
Under-5 mortality rate (1990): 189/1000
Annual number of under-5 deaths (1991) 71,000
Total fertility rate (1991): 8.5

Years of CCCD Involvement: 1984-1988

National Organization and CDC Resident Staff
National CCCD Program Director:
Dr. Augustin Ntilivamunda
National Malaria Coordinator:
Dr. Laurent Bugilimfura
Technical Officer:
Ms. Maryanne Neill

Major Donors
A.I.D., UNICEF

NOTABLE CCCD ACTIVITIES IN RWANDA: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1986
Malaria coordinating unit created: 1986

Operations Research

Drug Studies (in vivo testing by national or international teams)

1986
Conducted an in vivo and in vitro study of 138 children younger than 6 years of age in the Kigali and Butaré prefectures; study served as baseline surveillance data for following falciparum sensitivity to CQ

- In vivo response to CQ both 25 and 50 mg/kg in children showed similar benefits
- Although resistance existed, clinical and parasitologic improvement indicated that CQ should still be used
- In vitro testing indicated little resistance to MQ and quinine but high resistance to pyrimethamine

Investigated the efficacy of AQ and SP as second-line therapy for CQ-resistant *P. falciparum* in 98 children less than 6 years of age who were still parasitemic 14 days after treatment with CQ in Butaré and Kigali

- Showed both AQ and SP to be effective second-line drugs

1987
Assessed changes in sensitivity to CQ, SP, and AQ in the region of Butaré; to evaluate national treatment policy, compared results to the 1986 study
- No change found
- This study marked the beginning of long-term surveillance in 2 regions

Drug Sensitivity Surveillance System (7-day in vivo testing)

1987
- Started long-term surveillance in 2 regions

Other studies

1987
- Conducted entomology study in 3 regions to assess mosquito susceptibility to insecticide

Knowledge, Attitudes, and Practices (KAP) Surveys

1985
Conducted survey in 30 clusters (860 children less than 5 years of age) and in 10 health facilities in 7 prefectures to help develop national control policies and plans
- More than 4 in 10 (41%) of febrile episodes in children come to the attention of the health worker
- 42% treated at health center with injections
- 67% given pills or syrup
- Very little standardization in doses given of CQ at level of health centers
- Antimalarials out-of-stock at health centers
- Chemoprophylaxis for pregnant women not practiced

1986
Held focus group interviews to learn maternal, family, and community KAP about treatment of malaria
- Mothers were aware of the signs of malaria
- Mothers were willing to go to clinic if they suspected malaria
- Mothers' understanding of the means to prevent malaria was poor (about three-fourths believed vaccinations prevented malaria)

Health Unit Practices Surveys

1987
National and district supervisors visited health facilities in 4 regions to assess and correct performance problems
- During follow-up visits, showed improvement in quality of care in health facilities that were visited by national and district supervisors to assess and correct performance problems

Other Malaria-related Activities

1985
- At CCCD workshop in Zaire, 4 staff plus a technical officer trained to carry out in vivo drug response testing
- Initiated an intensive supervision plan to identify performance problems and monitor effectiveness of training to correct identified deficiencies

1986

- Increased standardized presumptive treatment of fever in children younger than 5 years of age from 43 health centers in 1985 to 86 health centers in 1986

1986-87

- Sentinel surveillance system established; documented increases in malaria morbidity between 1980 and 1987

1987

- Printed and distributed a graphic malaria treatment poster to guide health workers; poster served as prototype for several other African countries (Fig. 2-6)
- CDC malariologist brought in to assess the great increase in malaria morbidity; recommended need to emphasize early diagnosis, rapid treatment, and return to a medical facility if treatment did not reduce fever, among other measures

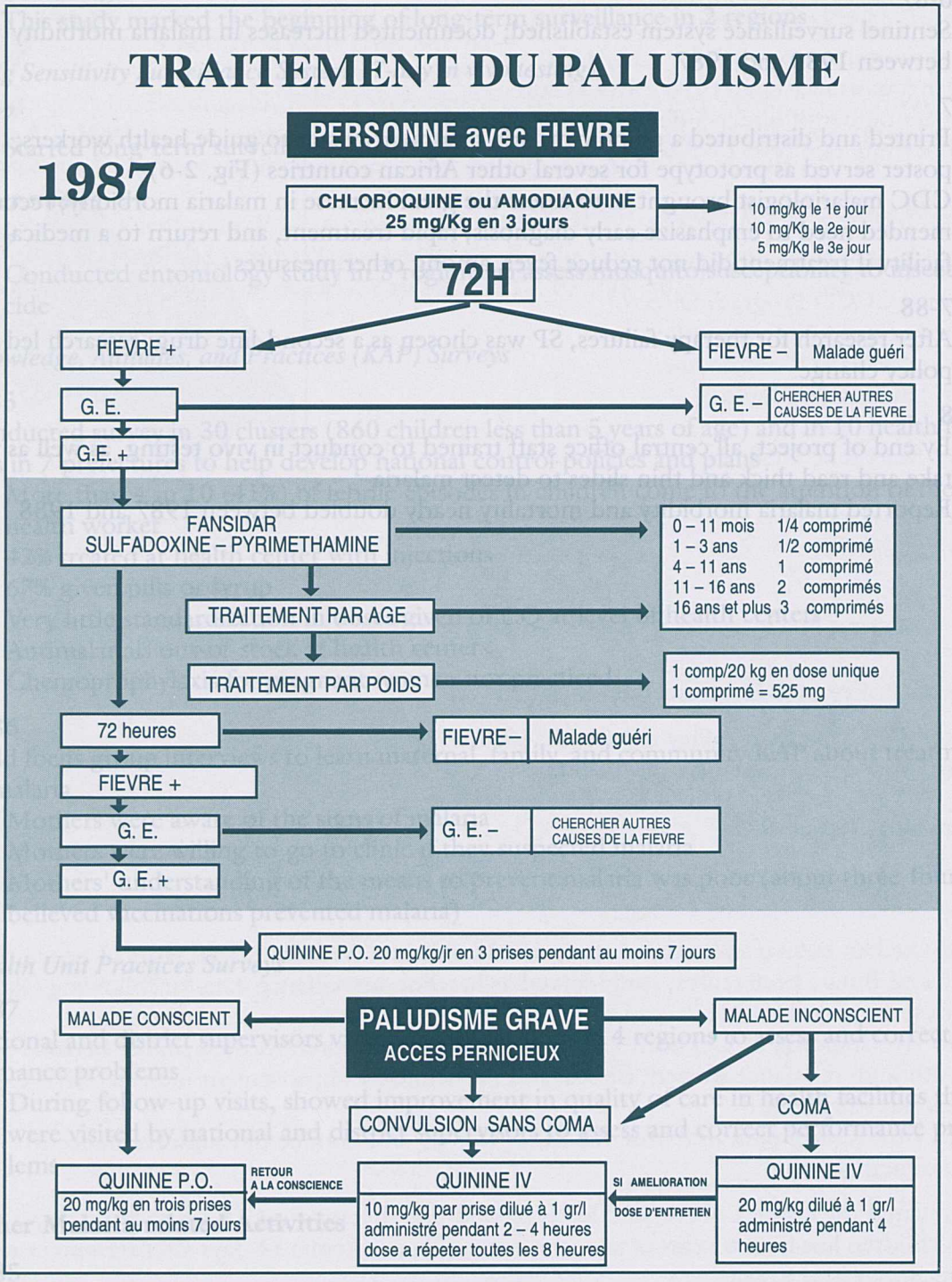
1987-88

- After research for therapy failures, SP was chosen as a second-line drug; research led to policy change

1988

- By end of project, all central office staff trained to conduct in vivo testing, as well as to take and read thick and thin slides to detect malaria
- Reported malaria morbidity and mortality nearly doubled between 1987 and 1988

Figure 2-6. Malaria Treatment Poster



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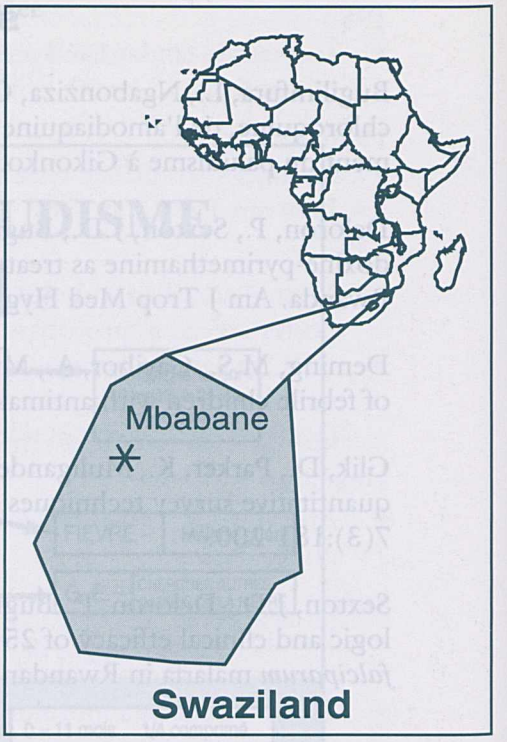
SWAZILAND



Country Data
Population (1991): 771,000
% infants with LBW (1987): 9.6
Infant mortality rate (1991): 76/1000
Under-5 mortality rate (1991): 113/1000
Annual number of under-5 deaths (1991): 3,300
Total fertility rate (1988): 5.0

Years of CCCD Involvement: 1984-1992

National Organization and CDC Resident Staff
National CCCD Program Directors:
Dr. Qhing Dlamini, Sister Gladys Matsebula,
Dr. Eddie McGrath (acting), Dr. John Ngubeni
National Malaria Unit Manager:
Mr. Simon Kunene
Technical Officers:
Mr. Larry Brown, Mr. John Nelson
Regional Epidemiologist:
Dr. David Heymann

Major Donors
A.I.D., Republic of South Africa, UNICEF, World Bank

NOTABLE CCCD ACTIVITIES IN SWAZILAND: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1988
Malaria coordinator named: Prior to CCCD

Operations Research

Drug Studies (7-day in vivo testing by national or international teams)

1985
35 parasitemic children younger than 5 years of age in Big Bend and St. Philip's mission (lowveld) treated with CQ in a dose of 10 mg/kg

- 34% had parasites resistant to CQ

1987
29 parasitemic children aged 5-13 years from schools located near St. Philips Clinic treated with 25 mg/kg of CQ

- 21% parasite-free at day 7

1988

- 70% level of CQ resistance found

1989

- Follow-up smears of patients treated as outpatients showed the level of CQ resistance dropped from 24% in 1988-1989 to 15% in the last half of 1989; decline attributed to absence of drug pressure on the parasite due to restricted use of CQ

Other studies

1990

Conducted a vector insecticide resistance study

- No evidence of resistance in vector mosquitoes (*An. gambiae sl.*) to insecticides used in malaria control program

1991

Analyzed data from active and passive case detection

- Malaria morbidity decreased by 50% from previous year

Knowledge, Attitudes, and Practices (KAP) Surveys

1990

Conducted a study in the lowveld of 719 mothers and 833 children

- Almost 25% of children with fever not brought to health center or treated with CQ at home
- Of 431 women under 35, 25% took malaria medicine the last time they were pregnant
- Of the children, 1% were treated with antimalarials before going to the clinic
- 76% seen by health worker or in clinic
- Rural Health Motivators consulted in 11% of fever cases
- Only 3% of those interviewed believed that traditional healers could cure malaria

1991

In January, conducted baseline survey to address mothers' compliance with the malaria treatment regimen in the lowveld area; in July, after staff formulated and implemented a communications plan, conducted a second survey with 217 people in 56 localities to determine effectiveness of health education messages

- 73% reported completing the prescribed medication
- Nearly 40% had seen or heard information about correct treatment practices
- 25% returned to the clinic if the fever did not decrease by the third day
- 17% sought treatment on the first day of the onset of fever
- For 74%, the source of information about malaria was a nurse or health worker; interpersonal communication the most effective channel for education

Health Unit Practices Surveys

1988

- All hospitals used malaria treatment policy; 25% used prophylaxis policy
- All other health facilities used both

1989

Visited 15 health facilities

- Seven facilities had CQ in stock; 7 did not

Vector Control

Vector control through spraying historically an essential part of malaria control program

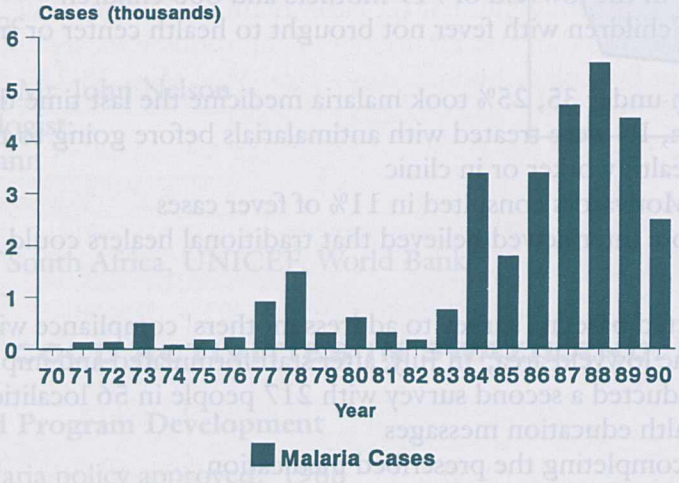
1983-87
- Because of inadequate supplies of DDT, homesteads were inadequately or incompletely sprayed

1988
- Spraying coverage, funded by South Africa, increased; used primarily in the lowveld, where malaria a significant problem

1989-90
- Further extended spraying coverage; decreased malaria incidence observed at sentinel sites (morbidity decreased by 25% since 1987-1988)

1990-91
- Vector control efforts credited with decreasing the number of malaria cases by 55% since 1988; only CCCD country with decreased malaria incidence (Fig. 2-7)

Figure 2-7. Malaria Cases, Swaziland, 1970-1990



Malaria Unit Statistics

1991
- South Africa greatly reduced its financial support in late 1991; the government of Swaziland then assumed responsibility for costs of spraying and case detection

Other Malaria-related Activities

1985
- Staff members taught in vivo drug response testing

1987
- Printed and distributed national malaria poster

1988-89
- Sentinel surveillance system established at 28 sites

1989
- Malaria staff outfitted with protective clothing and equipment for use in handling DDT and spraying

- Joint evaluation of malaria prevention (vector control) and malaria treatment (case management) completed
- Developed plans to strengthen surveillance, improve quality control of laboratory services, and carry out vector insecticide sensitivity studies

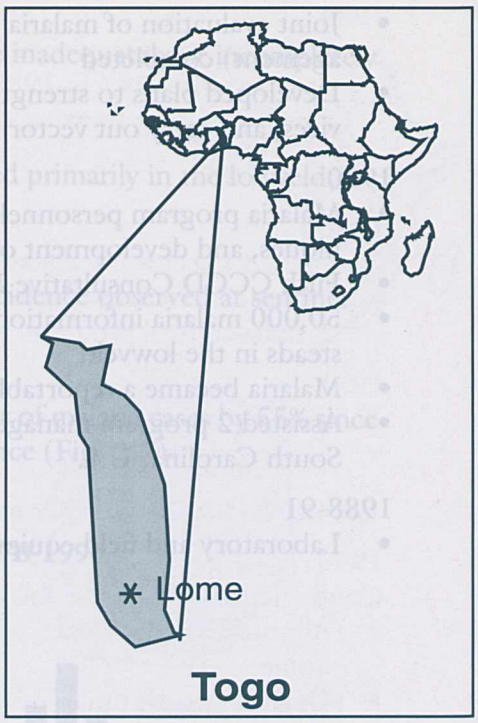
1990

- Malaria program personnel trained in entomologic field collection, identification techniques, and development of an insecticide susceptibility monitoring system
- Fifth CCCD Consultative Meeting held in Ezulweni
- 50,000 malaria information flyers printed for malaria sprayers to distribute to homesteads in the lowveld
- Malaria became a reportable disease and was included in monthly morbidity report
- Assisted 2 program managers to obtain further malaria training at the University of South Carolina, U.S.

1988-91

- Laboratory and field equipment supplied to facilitate research and prevention activities

TOGO



Country Data
Population (1991): 3,700,000
% infants with LBW (1990): 20
Infant mortality rate (1991): 88/1000
Under-5 mortality rate (1988): 144/1000
Annual number of under-5 deaths (1991): 23,000
Total fertility rate (1991): 6.6

Years of CCCD Involvement: 1983-1992

National Organization and CDC Resident Staff
National CCCD Program Directors:
Dr. Tchasseu Karsa, Dr. Yao Kassankogyo
Malaria Control Coordinator:
Dr. Anani Gayibor
Technical Officers:
Mr. Brian Fitzgibbon, Mr. Kevin Murphy,
Ms. Karen Wilkins
Research Coordinator:
Dr. Aristide Aplogan

Major Donors
A.I.D., FAC, Gesellschaft fur Technische Zusammenarbeit (German Technical Assistance), Peace Corps, UNICEF, WHO

NOTABLE CCCD ACTIVITIES IN TOGO: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1985
Malaria coordinator named: Prior to CCCD

Operations Research

Drug Studies
Active Studies (in vivo testing by national or international teams)

1984-85
- National drug sensitivity surveillance established
- 98% success rate with 10 mg/kg CQ among children younger than 5 years of age in the Maritime, Plateau, and Central Regions

1987
- 37.9% failure rate with 10 mg/kg CQ among 79 Peace Corps volunteers

1988
- 47% (53/113) failure rate with 10 mg/kg CQ; 17% (22/129) with 25 mg/kg AQ; 32% (90/278) with 25 mg/kg CQ (Tone, Kozah, Tchaoudjo, Kloto, Golfe)

Passive Studies (testing day 0 and day 7; only at local health facilities)

1985-present
- Passive routine monitoring system of drug sensitivity using 25 mg/kg of CQ in Lome
- As a result of studies, presumptive treatment changed from 10 mg/kg to 25 mg/kg in 1988
- No failures seen in 1985 and 1986 at the Service National du Paludisme (SNP), but among children treated with 25 mg/kg at 12 different centers, failure rates rose to 21% (91/432 children) in 1988 and 26% (201/769 children) in 1989

Knowledge, Attitudes, and Practices (KAP) Surveys

1984
- Nearly 80% of 507 children who had recently had fever were treated at home with CQ in Kloto, Wawa, and Haho prefectures
- Underdosing at home was more frequent than overdosing
- More than 4 of 5 mothers preferred oral medicine for the treatment of malaria
- CQ was frequently purchased on the open market

1987-88
- 36% of children were underdosed with 10 mg/kg in 1987; 77% were underdosed with 25 mg/kg in 1988 (Peace Corps volunteers conducted this survey)

1987, 1989
- Fever episodes per child increased from 8.8 per year in 1987 to 11.3 in 1989
- Overall, 96% of children with fever were treated at home
- Antimalarials were frequently obtained from open market (64% in 1984, 44% in 1987, 36% in 1989)

1990 or 1991 Field Survey
- 33% of treated children received recommended dosage of CQ

Health Unit Practices Surveys

1984
- 68% of febrile children treated with quinine injections at health centers in Kloto, Wawa, and Haho prefectures

1986
- Antimalarial drug prescribed to all febrile children seeking treatment at the 81 health facilities surveyed; 78% were given antimalarial treatment
- 47% received injections
- 57% of treatment doses were correct
- Use of injections for treatment of malaria declined from 56% in 1983 to 18% in 1986 in selected areas

1988
- 47% of treatments at dispensaries were injections

1989
- In selected areas, quinine injections were used in 9% to 28% of febrile children

Demographic and Health Surveys (DHS)

1988

- 43% of 2,768 children less than 5 years of age reported fever or a history of fever in the previous 2 weeks
- Prevalence of fever was higher in rural (45%) than in urban (39%) areas
- Nearly 31% of children were treated at a health center
- 56.5% of children were given nivaquine, and 11.2% were given injections

Other Malaria-related Activities

- Trained 600 peripheral health staff members in malaria treatment of uncomplicated illness and in criteria for referral
- Trained approximately 100 national and subdivisional staff in diagnosis and management of acutely ill patients in context of drug sensitivity studies

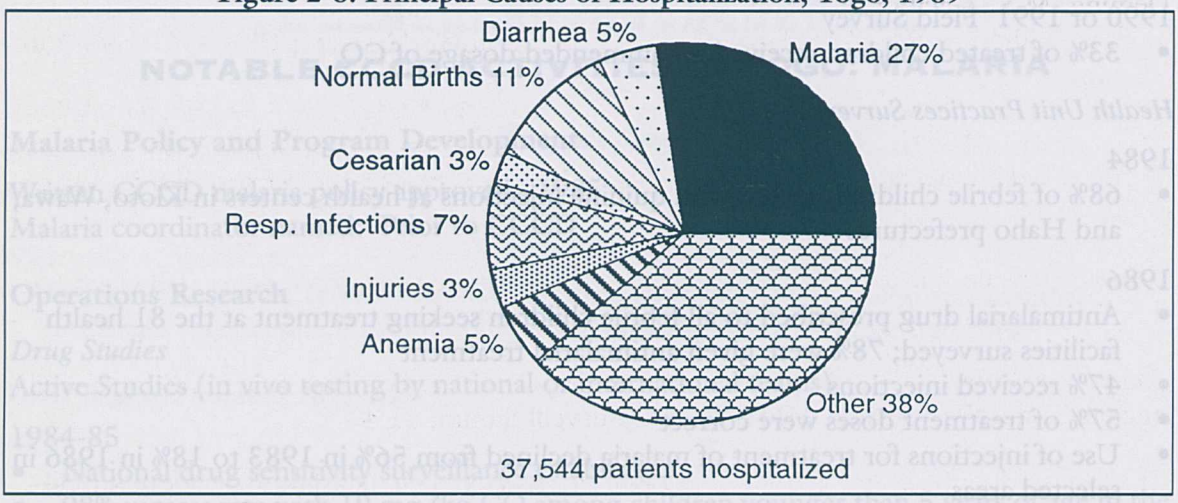
1989

- After training and supervision, use of injections declined from 47% in 1988 to 9% to 28% in 1989 in selected areas

1988-93

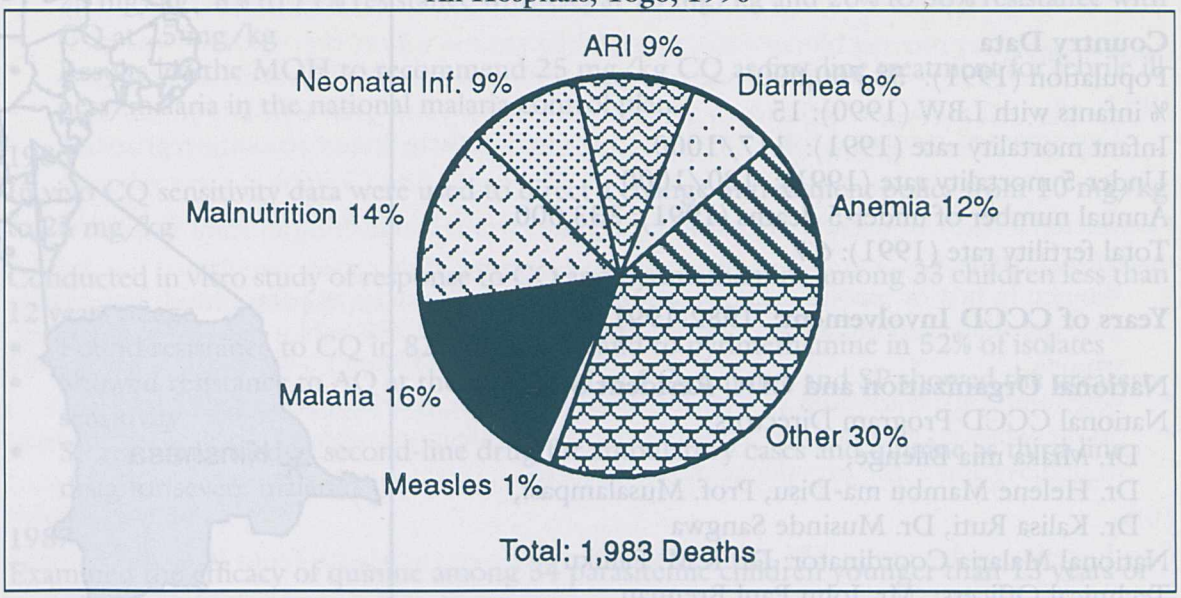
- Began health information system in 1988, expanded in 1989 with the installation of EPI-INFO software for national surveillance, further expanded in 1990 to include inpatient morbidity and mortality as well as outpatient morbidity (Figs. 2-8 and 2-9)
- Sentinel surveillance system served as a model for the development of facility-based reporting in Liberia, Burundi, Nigeria

Figure 2-8. Principal Causes of Hospitalization, Togo, 1989



Source: SNSS
Pediatric Clinic, CHU

Figure 2-9. Principal Causes of Death in Children Less than 5 Years of Age, All Hospitals, Togo, 1990



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ZAIRE

Country Data
Population (1991): 38,700,000
% infants with LBW (1990): 15
Infant mortality rate (1991): 117/1000
Under-5 mortality rate (1991): 180/1000
Annual number of under-5 deaths (1991): 333,000
Total fertility rate (1991): 6.7

Years of CCCD Involvement: 1982-1991

National Organization and CDC Resident Staff
National CCCD Program Directors:
Dr. Miaka mia Bilenge,
Dr. Helene Mambu ma-Disu, Prof. Musalampasi,
Dr. Kalisa Ruti, Dr. Musinde Sangwa
National Malaria Coordinator: Dr. K.M. Paluku
Technical Officers: Mr. John Paul Brennan,
Mr. Jean Roy, Ms. Karen Wilkins
Regional Epidemiologist:
Dr. Melinda Moore
Field Epidemiologists:
Dr. Melinda Moore, Dr. William Taylor, Dr. Andrew Vernon

Major Donors
A.I.D., Christian Churches of Zaire, Belgian Assistance (FOMETRO), OXFAM, Rotary International, UNICEF, WHO

NOTABLE CCCD ACTIVITIES IN ZAIRE: MALARIA

Malaria Policy and Program Development

Written CCCD malaria policy approved: 1986
Malaria coordinator named: 1985

Operations Research

Drug Studies (in vivo testing by national and international teams)

1983
First in vivo and in vitro CQ sensitivity tests conducted among 109 Kinshasa school children in Kinshasa and Mbuji-Mayi
- Found no resistance with 10 mg/kg single dose

1984
- Found resistance to CQ at both 10 and 25 mg levels with in vivo testing in Kinshasa

1985
Conducted a study of *P. falciparum* resistance to CQ in 4 sites

- Showed substantial resistance to CQ at 10 mg/kg and relative parasitologic efficacy of 25 mg/kg: 8% to 71% resistance with CQ at 10 mg/kg and 26% to 56% resistance with CQ at 25 mg/kg
- Results led the MOH to recommend 25 mg/kg CQ as first-line treatment for febrile illness/malaria in the national malaria control plan

1986

In vivo CQ sensitivity data were used to direct a change in treatment policy from 10 mg/kg to 25 mg/kg

Conducted in vitro study of response to CQ and pyrimethamine among 33 children less than 12 years of age

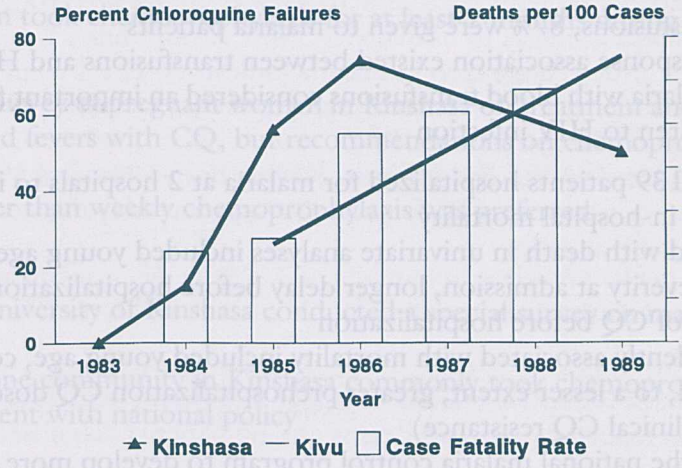
- Found resistance to CQ in 82% of isolates and to pyrimethamine in 52% of isolates
- Showed resistance to AQ at the same level as CQ; quinine and SP showed the greatest sensitivity
- SP recommended as second-line drug for ambulatory cases and quinine as third-line drug for severe malaria

1987

Examined the efficacy of quinine among 34 parasitemic children younger than 13 years of age

- Quinine found to be effective treatment

Figure 2-10. In Vivo Failures to CQ, Malaria CFRs, Kinshasa and Kivu, 1983-1989



Drug Sensitivity Surveillance System

1983

- Sentinel sensitivity surveillance system developed and conducted every 1-2 years thereafter

1986

- Response to antimalarial drugs in pregnant women added to the monitoring network, as well as survey of women's attitudes and practices toward chemoprophylaxis

1988

- Follow-up in vivo CQ sensitivity studies in primiparous women documented moderate levels of resistance

- Data from sensitivity surveillance contributed to the development of national malaria treatment strategies

Other Studies

1983

- Documented increased risk of malaria to women in their first or second pregnancies

1985

Conducted a study of malaria infection in pregnant women delivering in rural and urban maternity centers

- Women in first or second pregnancies had higher frequencies of parasitemia, higher parasite densities, and higher rates of still-born infants and LBW babies than other pregnant women
- Chemoprophylaxis would be best targeted to women in first or second pregnancies
- Studies showed fever a poor predictor of malaria infection; reported fever alone tended to underestimate the prevalence of parasitemia

1986

Conducted a study among 164 children seeking treatment at Mama Yemo Hospital's emergency ward or the pediatric outpatient clinic in order to investigate association between malaria and human immunodeficiency virus (HIV) infection

- Found that *P. falciparum* was not associated with HIV infection

Conducted a pediatric ward survey among 167 children less than 12 years of age at Mama Yemo Hospital

- Of all blood transfusions, 87% were given to malaria patients
- A strong dose-response association existed between transfusions and HIV seropositivity
- Treatment of malaria with blood transfusions considered an important factor in exposure of Kinshasa children to HIV infection

Conducted study of 139 patients hospitalized for malaria at 2 hospitals to investigate causes of malaria-associated in-hospital mortality

- Factors associated with death in univariate analyses included young age, female sex, greater clinical severity at admission, longer delay before hospitalization, and greater cumulative dose of CQ before hospitalization
- Factors independently associated with mortality included young age, coma, positive blood smear, and, to a lesser extent, greater prehospitalization CQ dose (suggesting but not confirming clinical CQ resistance)
- Results used by the national malaria control program to develop more specific educational messages for specific target groups

1987

Investigated the chemoprophylaxis delivery system at the Kingansani Maternity Center to assess the efficacy of monthly CQ chemoprophylaxis in 3,000 pregnant women

- Failed to show any effect on birth weight in the 2,000 women retained in study
- Methodologic problems existed with study: 1) nonavailability of lab confirmation, predelivery weights, and estimates of gestational age and duration of pregnancy at enrollment; and 2) 35% loss to follow-up

1988

Conducted a study at Mama Yemo Hospital in Kinshasa among 1,226 children

- Determined sensitivity and specificity of various diagnostic criteria for acute malaria

- Fever a poor predictor of parasitemia and might contribute to overuse of antimalarial drugs and undertreatment of other illnesses
- If fever were sole criterion for antimalarial therapy, 76% would get antimalarials, with a diagnostic accuracy of 40% and a treatment accuracy of 24%
- Parasitemic children were more likely to be anemic than those who were free of parasites
- Pediatric deaths attributed to malaria increased significantly during the first and second calendar years at Mama Yemo Hospital
- Malaria symptoms showed overlap with symptoms of pneumonia and septicemia

Found that parasitemic pregnant women in Kinshasa became free of peripheral parasitemia spontaneously without antimalarials after they gave birth

Knowledge, Attitudes, and Practices (KAP) Surveys

Coverage Surveys (conducted from 1980-1988 in Kinshasa and other urban areas, used WHO 30-cluster technique) included KAP questions about how children with fevers were treated for malaria at home and whether CQ was administered according to the recommended policies

1983

Conducted survey among 3,092 children less than 5 years of age and 1,791 mothers about home treatment

- 37% of children had a fever during the previous 2 weeks
- 69% of febrile children visited a health facility
- About one-third of febrile children received CQ, no matter where they were treated
- 34% of women took chemoprophylaxis for at least 2 months during their pregnancies

1986

Conducted KAP survey of pregnant women in Kinshasa on treatment and chemoprophylaxis

- Women treated fevers with CQ, but recommendations on chemoprophylaxis were not followed
- Monthly rather than weekly chemoprophylaxis was preferred

1985-87

Investigators at University of Kinshasa conducted a special survey on malaria in children in Kinshasa

- Residents of one community in Kinshasa commonly took chemoprophylaxis, a practice not in agreement with national policy

1990

Conducted a survey on personal protection practices in Kinshasa

- 91% of those bothered by mosquitoes tried to protect themselves from mosquitoes
- 18% of those used bed nets

1991

Conducted a national survey of mothers

- Percentage of febrile children who received an antimalarial within 24 hours varied from a low of 12% in Nord Kivu to 55% in Bas Zaire

Health Unit Practices Surveys

1987

- 70% of hospitals and outpatient facilities provided treatment
- 39% of hospitals and 49% of outpatient facilities provided malaria prophylaxis

1988

Conducted supervisory visits to 156 health centers

- Stocks of CQ were frequently interrupted
- 90% of centers had adopted basic strategy of treating children with fever presumptively with CQ
- 58% had abandoned chemoprophylaxis in infants
- 35% provided chemoprophylaxis in pregnant women

1989

Conducted supervisory visits in 5 rural health zones

- Approximately 90% gave oral antimalarial
- About 20% of mothers told to return if children not better

1990

Conducted supervisory visits in 68 zones

- 14% of zones had stock interruptions for CQ in month prior to visit
- 91% of fever cases treated with CQ, up from 67% in 1989
- Found stability in numbers of cases compared with previous years, but found inconsistent trends in CFRs

Mortality and Use of Health Services (MUHS) Surveys

1984-85

- Baseline surveys conducted in 2 health zones in rural Zaire–in Kingandu and Pai Kongila in Bandundu Region

1988-89

Kingandu resurveyed: little change seen in malaria indicators

- Proportion of children with fever treated presumptively for malaria with CQ basically unchanged: 47% in 1984 and 44% in 1988
- Proportion seen at health facilities the same: 45% in both 1984 and 1988
- Under-five mortality rate decreased by nearly 22%, presumably due to control of other diseases, most notably measles

Other Malaria-related Activities

1984

- Monthly report of presumptive malaria begun at 121 health centers and 43 major hospitals; hospitals also reported cases and deaths among patients diagnosed with malaria

1985-86

- CCCD health staff members (central and peripheral) trained to conduct in vivo testing

1986

Investigated malaria mortality among hospitalized children

- Proportional malaria admission rate increased from 29.5% in 1983 to 56.4% in 1986
- Proportional malaria mortality rate increased from 4.8% in 1982 to 15.3% in 1986

Began providing CQ through cost recovery program; produced locally at Laboratoire Pharmaceutique de Kinshasa

1989

- Zairian trained by CDC to conduct in vivo testing provided training and expert consultation to Guinea

1990

- MOH planned to simplify surveillance system by decreasing morbidity and mortality data on forms and focusing on the collection of management program process indicators of revised national HIS; civil disturbances prevented implementation
- Produced a treatment poster to be used by health personnel for correct CQ doses by age and weight
- University of Kinshasa conducted second francophone regional training course in patient education and malaria; participants from Zaire, Côte d'Ivoire, Madagascar, and the Congo

1991

- A team from the MOH and the Institut National de Recherche Biologique investigated an outbreak of severe malaria in North Kivu in which 187 people died; probable cause for the severity was the recent importation of malaria into a previously nonmalarious area

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Vernon, A., Taylor, W., Biey, A., Mundeke, K.M., Chahnazarian, A., Habicht, H., Mutombo, M., and Makani, B. 1993. Changes in use of health services in a rural health zone in Zaire. Int J Epidemiol. In press.

Sources and Notes for Part Two

Sources

All data appearing in Country Data sections in Part Two were taken from UNICEF's *The State of the World's Children 1993* with these exceptions:

Nigeria
Population–1990 Nigerian Census.

Swaziland
Percentage of low birth weight–Maternal and Perinatal Mortality in Swaziland for 1987. Report compiled by Jeanne McDermott.

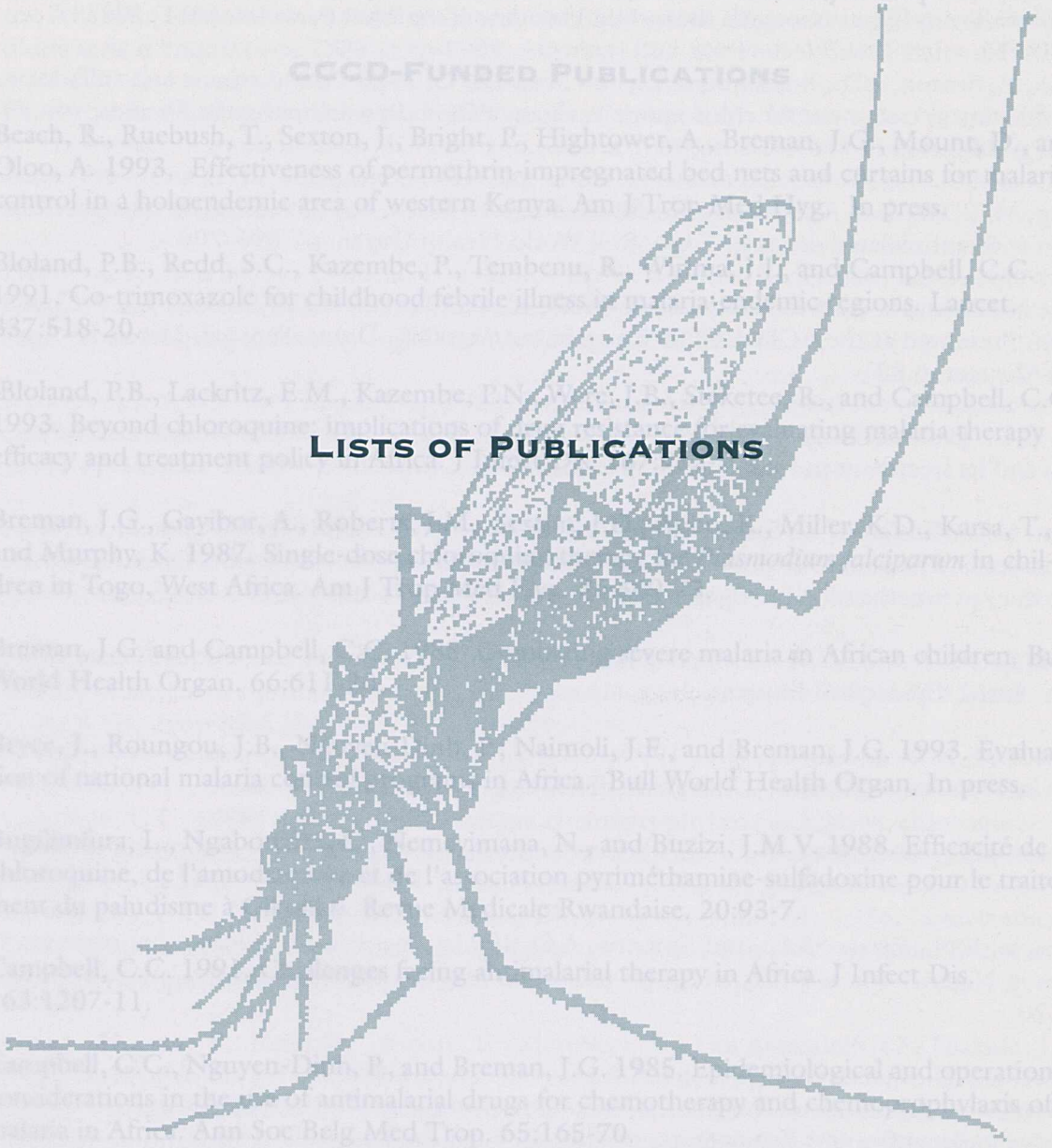
Total fertility rate–1988 Family Health Survey. Swaziland Ministry of Health Final Report.

Notes

Low birth weight (LBW): Less than 2,500 grams (5.5 pounds).

Under-5 mortality rate: Number of deaths of children less than 5 years of age per 1,000 live births. More specifically, the probability of dying between birth and exactly 1 year of age.

Total fertility rate: The number of children that would be born per woman, if she were to live to the end of her child-bearing years and bear children at each age in accordance with prevailing age-specific fertility rates.



Lists of Publications

Sources and Notes for Part Two

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All data appearing in Country Data sections in Part Two were taken from UNICEF's *The State of the World's Children 1993* with these exceptions:

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Population–1990 Nigerian Census.

Swaziland
Percentage of low birth weight–Maternal and Perinatal Mortality in Swaziland for 1987. Report compiled by Jeanne McDermott.

Total fertility rate–1988 Family Health Survey. Swaziland Ministry of Health Final Report.

Notes

Low birth weight (LBW): Weight at birth of 2500 grams (5.5 pounds).

Under-5 mortality rate: Number of deaths of children under 5 years of age per 1,000 live births. More specifically, the probability of dying between birth and exactly 1 year of age.

Total fertility rate: The number of children a woman would have born per woman, if she were to live to the end of her child-bearing years and bear children at each age in accordance with prevailing age-specific fertility rates.

The following lists attempt to provide a comprehensive catalog of documents written by those involved in the malaria component of CCCD. The first list is composed of work directly funded by AID, and the second gives titles of documents linked closely to CCCD work, but not funded directly by AID. In some cases, the two lists may overlap.

CCCD-Funded Publications

Beach, R., Ruebush, T., Sexton, J., Bright, P., Hightower, A., Breman, J.G., Mount, D., and Oloo, A. 1993. Effectiveness of permethrin-impregnated bed nets and curtains for malaria control in a holoendemic area of western Kenya. Am J Trop Med Hyg. In press.

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CCCD-Related Publications

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