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Combating severe malaria in African children*

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

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

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

INTRODUCTION

Malaria remains one of the most widespread infectious diseases in Africa. Over 90% of the 450 million persons in Africa south of the Sahara live in malarious areas. The epidemiology of malaria transmission and disease varies greatly and depends on topography, rainfall, and human behaviour. The prevalence of

Plasmodium falciparum infection in endemic areas is frequently over 50%, with the highest rates occurring in children (1). In most communities the incidence of acute illness is difficult to measure because of the imprecision in clinical diagnosis and lack of microscopic confirmation. About 3 to 10 million cases are reported annually by countries in the WHO African Region (E. Beausoleil, personal communication, 1987), but because of incomplete and irregular reporting these data are of limited value. WHO considers that 80% of the 100 million cases of clinical malaria occurring in the world each year are from Africa south of the Sahara (2). The risk of severe and potentially fatal *P. falciparum* infection is greatest in

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

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

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

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

The aim of the Africa Child Survival Initiative—

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

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

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

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

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

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

DEFINITION OF EFFECTIVE THERAPY

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



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

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

The results of *in vivo* drug-sensitivity surveillance studies performed by the CCCD malaria units in children since 1982 are shown in Table 1. The objective of drug-sensitivity surveillance is the provision of information that can be used to establish and monitor treatment regimens. Minimum data required include the clinical response to treatment (essentially a reduction in fever) and decrease in parasitaemia. For this, a simplified version of the WHO *in vivo* drug-sensitivity test (10) has been developed and requires only 2-3 follow-up visits (8, 11). *In vitro* assessments have been performed infrequently, and almost always by consultant teams. *In vitro* testing has been de-

emphasized because the data collected are less useful for operational decision-making, and the method requires laboratory staff to do this work regularly in order to maintain their skills, using reagents and materials that are expensive and not readily available. *In vitro* testing will be used on a limited basis for quantitating the parasite response to chloroquine and to potential alternative compounds and only as an adjunct to *in vivo* testing.

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

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

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

^a Success defined as no parasites detectable on day 7 post-treatment.

^b Figures in parentheses are percentages.

^c Only the 10 mg/kg dosage was tested at one site and 86/93 (92%) were successful at this site.

^d Dosage of 50 mg/kg divided over 5 days was given to another group; 23 out of 49 children so treated were successful (47%).

^e At one site 36 children all responded successfully.

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

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

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

The development of specific diagnostic criteria and indications for therapy is important for preserving the efficacy of antimalarial drugs as well as for preventing progression to severe illness. *Plasmodium* parasitaemia is not a *sine qua non* for initiating treatment because microscopy, which is required traditionally for a diagnosis, is impractical in most of Africa. The child's clinical status must be the deciding factor in determining if malaria therapy is appropriate, and whether oral or parenteral treatment is needed. The following clinical indicators have been used in evaluations of the response to chloroquine therapy of children in CCCD countries with CRPF: neurological status, fluid balance, temperature, and the subjective

impressions of parents and clinicians. The best indicators for diagnosing malaria and following the clinical response to treatment are a history of recent fever and a measured rise in body temperature (M. Pappaioanou, unpublished observations, 1986). Recently, hypoglycaemia has been shown to be a risk factor for severe (including cerebral) malaria and death in African children (23). Very ill patients require special clinical care following established guidelines (24).

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

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

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

DELIVERY SYSTEMS FOR MALARIA CONTROL

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

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

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

the Congo, Rwanda, and Zaire the treatment was more often obtained from the health units.

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

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

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

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

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

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

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

^a Fever present in the two weeks prior to the interview.

^b Figures in parentheses are the numbers of children in the surveys.

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

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

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

MALARIA CONTROL IN PREGNANCY

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

less effective against malaria infections in women in their first and second pregnancy compared with the response in non-pregnant women or those in later pregnancies (29). Operational research to assess the efficacy of alternative approaches as well as to identify those pregnancies at greatest risk is being carried out in the CCCD countries. Such studies are essential to develop a more rational policy for pregnant women.

HEALTH EDUCATION AND TRAINING

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

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

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

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

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

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

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

^a Figures in parentheses are percentages.

^b Question asked to 9857 women only.

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

PROGRAMME IMPACT

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

Infant and childhood mortality have been estimated recently in some areas of Liberia, Togo and Zaire by CCCD staff.^k In these countries, the infant mortality rates are between 78 and 215 per 1000 live births, and under-5 mortality between 191 and 365 per 1000 live births, figures that may be useful indicators of the overall effect of the CCCD programme, and of other interventions for national development. These surveys were conducted early in the programme by interviews with women who had been pregnant in the preceding six years; therefore, the causes of death

could not be determined. Sentinel hospital surveillance, prospective population-based surveys or other imaginative approaches will be needed to determine the frequency of severe illness and disease-specific mortality.

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

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

^k CENTERS FOR DISEASE CONTROL. *Combating childhood communicable diseases, 1985 annual report*. Atlanta, 1986 (International Health Program Office internal document), pp. 18-19.

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

NATIONAL COMMITMENT

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

Eleven of 12 endemic countries with CCCD projects now have malaria control units and have a written CCCD malaria control plan; only 4 of these units existed when the CCCD project began and all

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

CONCLUSION

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

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

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

^a Lesotho has no endemic malaria.

^b Year when the CCCD programme began is given in parentheses.

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

A strategy to ensure prompt recognition of probable malaria infections followed by effective treatment is the first step towards the control of malaria. Drug therapy may decrease the risk of severe infection, but will not, by itself, alter transmission in the community. The health care system, linked to effec-

tive community mobilization, is essential for these immediate drug distribution initiatives to succeed. The infrastructures developed in these programmes represent the nucleus around which more comprehensive malaria control efforts can develop (32). These activities can also provide the stimulus for development of a more comprehensive health care delivery system.

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RÉSUMÉ

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

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

Les activités du CCCD en matière de lutte contre le paludisme visent à aider les pays à recueillir des informations, à élaborer des stratégies nationales et à les mettre en œuvre. Depuis 1982, 9 des 13 pays ont étudié la sensibilité de *Plasmodium falciparum* à la chloroquine chez l'enfant et ont établi un réseau de surveillance de la chimioprophylaxie. Même dans les régions où *P. falciparum* est chloroquinorésistant, on a constaté que le traitement à la

chloroquine faisait baisser la température des enfants fiévreux et amenait une réduction importante de la densité des parasites, empêchant ainsi l'apparition de formes graves et éventuellement mortelles de la maladie. Les enquêtes effectuées dans 6 pays ont mis en évidence une grande variation dans les modalités du traitement; c'est ainsi que la chloroquine est utilisée à des doses variables par les familles et que les centres de soins font un usage excessif des injections de quinine. Etant donné que, bien souvent, les femmes enceintes ne suivent pas de traitement chimioprophylactique, des recherches ont été entreprises pour trouver d'autres solutions, afin d'éviter les effets néfastes du paludisme sur le fœtus.

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

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