

*WORLD HEALTH ORGANIZATION
TECHNICAL REPORT SERIES*

No. 537

Malaria Control in Countries Where Time-Limited Eradication is Impracticable at Present

**Report of a
WHO Interregional Conference**

This report contains the collective views of
an international group of experts and does not necessarily
represent the decisions or the stated policy of the
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Report of a WHO Interregional Conference

INTRODUCTION

The WHO Interregional Conference on Malaria Control in Countries where Time-Limited Malaria Eradication is Impracticable at Present was held at the WHO Regional Office for Africa, Brazzaville, from 30 October to 10 November 1972. The Conference was attended by representatives of 31 countries and territories from WHO African, Eastern Mediterranean, and Western Pacific Regions. Also present were observers from UNDP, UNICEF, a number of intergovernmental organizations, and other institutions. A list of participants is given in Annex 1.

Opening addresses were given by Mr Dieudonné Itoua, the Minister of Health of the People's Republic of the Congo, and by Dr A. Quenum, Director, WHO Regional Office for Africa.

1. REVIEW OF THE MALARIA SITUATION AND OF ANTIMALARIA ACTIVITIES

In preparation for the Conference, the WHO Secretariat collected a large amount of information on the socioeconomic profile and the status of antimalaria programmes in the countries concerned. These data, obtained by means of a questionnaire circulated to the governments, were in many cases supplemented and expanded by participants in statements to the Conference, in which they outlined the malaria situation in their countries and described the main problems of malaria control,

These data are summarized in Annex 2 and subsequent discussion revealed the following points:

Of the total population of 250 209 000 in the African Region of WHO, 230 340 000 people live in areas that were originally malarious. Only 4 427 000 people live in areas for which eradication is claimed (areas in the maintenance phase)¹ while an additional 19 661 000 people are protected by some measures aimed either against the vector or against the parasite.

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1971, No. 467, p. 17.

However, 206 251 000 people live in areas without any specific antimalaria measures.

The total population of the countries in the African Region participating in the Conference is estimated at 201 424 000, and according to reports presented at the Conference, about 180 000 000, or some 90 % of the total population, remains exposed to malaria infection without any organized protection.

In addition to countries belonging to the African Region of WHO, 24.2% of the 41 895 000 population of Ethiopia and Sudan, or more than 10 000 000 people, are not protected against malaria infection.

In the Western Pacific Region of WHO, although the population of the New Hebrides still remains unprotected, about 50% of the population has been brought under a control programme in Papua New Guinea.

The data submitted by the governments concerned are incomplete and fragmentary. The number of recorded cases of malaria reflects mainly cases reporting to, and treated by, hospitals or other health establishments and does not indicate the true prevalence of malaria.

Malaria mortality rates vary from 0.007% to 1.3%, and show little if any relationship to the known degree of endemicity of malaria in the countries concerned.

The number of blood slides examined also shows great variation ; this is due to the fact that in some countries large numbers of slides collected during malaria surveys were included in the records, while in other countries less than 2% of hospital cases diagnosed as malaria underwent a blood examination. The slide positivity rate, which varies from 1.5% to 55%, is of limited epidemiological value since the slides were obtained from very diverse population samples.

The proportion of persons with a diagnosis of malaria reported from various health units showed a range varying between 0.03% and 26% ; obviously the figures depend on the type of unit reporting. These results indicate that the true amount of malaria and its severity cannot be judged from data collected from hospitals and dispensaries only, and that the assessment of the impact of endemic or epidemic malaria on the community must be based on more reliable sources of information. The opinion was expressed that where this information cannot be provided by efficient vital statistics services a malaria service should be able to reveal the real effect of malaria on the community and to indicate the severity of the damage that it inflicts on the country concerned.

2. NEW CONCEPT OF A MALARIA CONTROL PROGRAMME

2.1 General aspects of malaria in tropical Africa ¹

Africa is the second largest continent and has one-quarter of the world's land surface. There is no other part of the world where the combined influence of high temperature and deficient rainfall creates such serious problems for man's survival and fitness. In many areas the soils are exhausted and eroded so that the use of land is limited to nomadic pastoralism. Soil erosion and adverse climatic conditions may explain, at least partly, why Africa, with about 17% of the world's arable land and 23% of the world's pasture land, produces no more than about 4% of the world's agricultural output.

In 1930 it was estimated that the population of tropical Africa numbered 164 million, but in 1962, on the basis of several newer censuses, the estimated figure was 270 million. With an annual population growth rate of 2.5–3% as reported from many African countries, it is likely that this population will increase to about 370 million in 1980; in the year 2000 the figure may be well in excess of 600 million.

Africa's health situation can be crudely assessed from the following indices: neonatal mortality, 50–80 per 1000 births; infant mortality, 100–200 per 1000; and cumulative mortality from 0 to 5 years of age, 300–500 per 1000. Childbirth in these areas often means a maternal death rate of 5–10 per 1000 deliveries, i.e., 10–20 times higher than in Europe.

The expansion of health services is limited by the supply of trained manpower; although the mean ratio is 1 doctor to 20 000 people in some countries of Africa, in many villages the ratio is of the order of 1: 80 000 or worse.

The cities of Africa are growing faster now than European cities did during the industrial revolution. If the current mean annual growth rate in the urban population of 8–10% continues the number of town-dwellers will double every 15 years and will overwhelm the capacity of the slowly expanding social services.

Some characteristics of the form of endemic malaria found in a large portion of Africa south of the Sahara can be deduced from the term "stable malaria", which emphasizes that neither the very high prevalence of the disease, nor the degree of transmission, are substantially altered by seasonal changes in environmental factors such as temperature, humidity, rainfall, or even the density of vectors. The link between the stability of malaria and type of vector is close; in tropical Africa the stability is due to the

¹ The terminology is explained in: *Terminology of malaria and of malaria eradication*, Geneva, World Health Organization, 1963.

wide distribution of *Anopheles gambiae* and *A. funestus*, their breeding habits, their preference for feeding on man, the ease with which they transmit the plasmodia, the long life span of the mosquitos, and other factors.

Epidemics of malaria are generally limited to the highlands where transmission is at a low level or sharply seasonal. Such epidemics can be of considerable severity, with high incidence in all age groups and high mortality not only among the young but also among those adults whose health has been undermined by malnutrition or other intercurrent diseases.

The distribution of *Plasmodium falciparum*, *P. vivax*, *P. malariae*, and *P. ovale* in Africa was recently outlined in the report of the WHO Scientific Group on the Parasitology of Malaria¹ and need not be further discussed here.

Perhaps the most striking characteristic of malaria in most parts of Africa is the intensity of transmission, that leads to a unique degree of immune response. The resulting clinical and epidemiological picture of infection in the community is complex and can be divided into 4 successive stages of the host-parasite relationship—those occurring in the infant, the toddler, the older child, and the adult.

In spite of the high frequency of placental infections in the immune or semi-immune mother, congenital malaria in the newborn is very rare in Africa. Nevertheless, the influence of heavy infection of the placenta (mainly by *P. falciparum*) is considerable. The birth weight of infected babies is usually 10–15% lower than the average for African babies, thus creating a severe neonatal handicap and contributing to the high neonatal mortality rate.

There is a phase of passive immunity transmitted to the baby from the mother across the placenta. Thus a large proportion of infants remain free from patent infection for up to 3 months, or even longer, in spite of the high degree of transmission. There is good evidence that this protective “biological shield” is due to the presence of high levels of immunoglobulins IgM and especially IgG in the cord blood and plasma of infants born of immune mothers. It has been postulated that some other factors (milk diet, presence of fetal haemoglobin, selective biting of vectors) are responsible for the transient protection of African infants but it seems that they play only a minor part.

During the early period of life successive parasitic invasions induce the defence mechanism of the child to produce some active immunity, but this is acquired slowly and over the first 3–5 years of life the incidence and severity of malaria are high. From the fifth year onwards the effect of acquired immunity becomes increasingly obvious. The parasite density is still high (5000–20 000 per mm³ of blood) but already decreasing; enlargement of the spleen is common. In older children parasitaemia decreases but

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1969, No. 433.

there are bouts of high parasite counts interspersed with long periods of scanty plasmodia and the splenic enlargement, though still high, begins to recede. In adolescents this process is more marked and in adults the mean parasite rate is rarely higher than 20%, with parasite counts well below 1000 per mm³. However, longitudinal studies with repeated blood examinations have shown that the true prevalence of plasmodial infection in adults is as high as 80–90% although the level of parasitaemia is low. The mean spleen rate of the adult population is low (10–15%) but in fact the spleen of adults remains enlarged to about twice its normal size; this enlargement cannot usually be detected by palpation.

Generally speaking the adults in areas with stable malaria achieve a high degree of immunity to the infection, so that the incidence of clinical malaria is low and rarely severe. However, during the second half of pregnancy African women seem to lose some of their immunity and show an increased incidence of clinical malaria or of other symptoms (anaemia) associated with adverse effects of increased parasitaemia due to *P. falciparum*.

The estimates of the actual incidence of malaria in Africa and the mortality caused by it carry a wide range of uncertainty. Strictly speaking the malaria infection rate of populations in holoendemic or hyperendemic areas of Africa is of the order of 90–95%, with considerable variations from place to place and from season to season. As stated above, hospital statistics do not present an accurate picture since the clinical diagnosis of the disease is variable.

On the basis of a few past studies it can be estimated that malaria is directly responsible for about one million deaths annually of infants and children below the age of 14 years. The indirect effects of malaria as a contributory cause of morbidity and mortality cannot be estimated with any certainty but must be considerable.

The relationship between malaria and malnutrition was mentioned by several speakers. It is probable that malaria contributes to malnutrition in children but there is no clear evidence of this association. Research on this problem is urgently needed.

2.2 Previous antimalaria programmes

While attempts at malaria control have been carried out in Africa for the past half-century, a number of pilot projects assessing the feasibility of malaria eradication were instituted from the 1950s onwards.

In the pilot projects conducted either in forest areas or in the highlands, in the past 20 years, on the mainland of Africa (Liberia, south Cameroon, Uganda), interruption of malaria transmission was almost achieved. In these projects, *A. funestus* virtually disappeared and the numbers of *A. gambiae* decreased spectacularly.

In the remaining pilot projects carried out during the same period, extending from Senegal in the north to Southern Rhodesia, interruption of transmission was not achieved, though in most of them there was a considerable degree of control.

It is pertinent to mention here that the island of Mauritius is now at the end of a successful eradication programme. *A. funestus* disappeared within 2 years following the introduction of DDT spraying, and the density of *A. gambiae* showed a striking decrease. The absence of indigenous malaria in Mauritius, demonstrated by an excellent surveillance system, has now been confirmed by the results of an immunological survey.

However, it has not been possible to launch full-scale malaria eradication programmes on the African mainland for a number of administrative and technical¹ reasons. Among these the resistance of *A. gambiae* to residual insecticides (particularly dieldrin and HCH) should be mentioned, although resistance to DDT is not yet widely distributed.

An insecticide such as DDT, which combines a small effective dosage with a long residual action and with comparatively low cost, is particularly important in rural African conditions of relatively low population density, shortage of trained labour, and poor communications. The large-scale use of alternative, more expensive new insecticides with shorter residual action may not be feasible under present conditions because of financial limitations.

The opinion has been expressed that the widespread use of insecticides has decreased interest in methods of source reduction and that the time has come to revert to some of these economical sanitary practices. This should lead to greater participation of the community in improving their environmental amenities and also in accepting the teachings of health education.

While it is generally agreed that an excellent degree of malaria control can be achieved by chemoprophylaxis or chemotherapy in small highly organized communities under strict supervision, such a degree of malaria control (let alone eradication) has never been attained in ordinary communities in tropical areas, mainly because of practical difficulties of drug administration.

On the other hand, it is probable that the association of chemotherapy with residual spraying will be the only way of gradually eliminating malaria from those tropical areas where the degree of transmission is extremely high. It is not possible to predict the success or failure of this combined method on the basis of existing knowledge and practical experience (see also page 44).

¹ WHO (1969) Re-examination of the global strategy of malaria eradication, *Off. Rec. Wld Hlth Org.*, No. 176, Annex 13

2.3 Some socioeconomic problems of antimalaria programmes in Africa

In tropical Africa malaria is an insidious, ever-present enemy that results in the death of infants and young children, saps the energy and strength of the people, interferes with education, decreases labour output, and prevents or slows down economic development. And yet, because of the absence of epidemic malaria, this steady wastage of life and human assets is not conspicuous or dramatic enough to attract greater attention.

The cost of malaria control is of paramount importance. The economic possibility of malaria control within the general framework of medical and health services presents a challenging dilemma in many countries. The expansion of malaria control activities to cover all the population at risk is often limited by the fact that the lowest estimates of cost often represent between 50% and 100% of the total medical and health budget per head per year.

Development planners, economists, and health administrators, though agreeing on ultimate objectives, may still disagree about the amount that can be spent on health services. From replies to the questionnaires it appears that the proportion of the health budget to the total government budget is less than 5% in 7 out of 28 countries and less than 2% in 3 out of 28 countries. In terms of the actual amount available for all health activities per inhabitant per annum this represents less than US\$ 3 in 21 and less than US\$ 1 in 11 countries. However, it must be admitted that the relationship between the proportion of the annual budget devoted to health and the quality and quantity of services obtained is not a direct one. In some countries, the budgetary expenditure on health may appear to be low, but the provision of funds by local authorities, cooperatives, or other bodies may increase the apparently low budgetary allocations from central funds.

There is little evidence of any substantial increase in the proportion of the government budget allocated to health over the past decade. Table 1 gives some idea of the amounts spent on health in some countries.

TABLE 1. HEALTH BUDGET AS A PROPORTION OF TOTAL BUDGET AND FUNDS AVAILABLE PER CAPITA IN 1963-64 AND IN 1971 IN SOME COUNTRIES

Country	1963-64		1971	
	Proportion of total budget (%)	Per capita amount (US \$)	Proportion of total budget (%)	Per capita amount (US \$)
Indonesia	2.8	0.20	1.2	0.11
Malawi	5.8	0.64	3.3	0.31
Nigeria	12.0	0.50	1.3	0.27
Senegal	6.6	3.47	7.2	3.3
Sudan	4.8	1.02	6.0	1.6

As expenditure on health cannot always be expressed in terms of economic benefits, the views of development planners (biased towards economic considerations) and health planners are often to some extent at variance. Economic development may contribute to improving standards of living and to solving many health problems not only through the achievement of its primary objectives but also as a result of indirect effects. In many cases, however, insufficient attention is paid to human factors and the secondary consequences, some foreseen, some unforeseen, are often adverse. These consequences may create specific hazards to health; they certainly create a range of new human needs which, if unsatisfied, lead to a deterioration in standards of health. Some of the major problems of our time have their origin in this type of economic evolution and it is open to question if this represents true economic development.

2.4 Principles for a methodology of malaria control

Malaria control programmes have been defined in the fifteenth report of the WHO Expert Committee on Malaria¹ as follows: "An organized effort to carry out those antimalaria measures that are possible with the available resources and suitable under the prevailing epidemiological conditions, with the objective of achieving the greatest possible reduction of mortality and morbidity". It may be added that such an organized effort will in the long run give rise to conditions under which an all-out assault on the disease, will be possible.

The development of a methodology for malaria control must take into account the following points:

- (1) the epidemiological features of malaria, its adverse effects on health and the economy, and its level of priority among other health problems;
- (2) the technical feasibility of a malaria control programme and the operational facilities that would be necessary to make it a sound investment;
- (3) the socioeconomic profile of the country and the human and financial resources available for health promotion;
- (4) the health structure of the country, the possibility of expanding the health services, and their potential effectiveness.

It is apparent from the above that it is not possible to prescribe a standard malaria control methodology for all countries, but that certain principles and guidelines have to be kept in mind in developing a strategy that would suit a particular country and provide optimum results under different situations.

A malaria control scheme must be adjusted to the socioeconomic profile of the country. The main socioeconomic information can be obtained from

Wld Hlth Org. techn. Rep. Ser., 1971, No. 467.