Malaria and the work of WHO*

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Malaria has been one of the main health problems demanding the attention of WHO from the time the Organization was created. This review of the historical record analyses the different approaches to the malaria problem in the past 40 years and shows how WHO tried to fulfill its constitutional mandate. The article exposes the historical roots of the present situation and helps towards an understanding of current problems and approaches to malaria control.

Introduction

During the last 40 years, both the global malaria problem and the ways it was perceived by the health authorities in endemic countries and by malaria specialists, the scientific community, international collaborating agencies, and WHO have changed considerably. As a result, important changes were made in the global malaria control strategy which were reflected in the national budgetary allocations and international support for antimalaria programmes. These changes gave rise to serious criticisms and recriminations, not only of the individual decisions but also of WHO as the supposed originator of mistaken policies.

In fulfilling its constitutional mandate and in trying to respond to the demands of Member countries and the resolutions of its governing bodies, WHO has had to react to contradictory influences and pressures from various sources, e.g., health planners who asked for clear and simple policy guidelines, the scientific community who often asked for rapid translation into action of the latest scientific contributions, the health authorities who tried to resist administrative changes and increased expenditure, and the malaria specialists who resisted conceptual changes and felt committed to previous policy statements. The purpose of this review is not to investigate individual responsibilities or decide whether the eradication policy or the change in favour of malaria control was correct, but to explore the historical roots of the present situation and help understand what may be the best course of action today.

Antecedents

The global importance of malaria as a major public health problem and a serious obstacle to socioeconomic development was well established before the Second World War. It was also widely recognized that medicine and public health had effective means for, respectively, treating the disease and controlling or preventing its transmission. Malaria control had been successful in a variety of situations, as described in the scientific literature, and there was a tendency to extrapolate the value of these experiences without taking into account all the possible factors that may have contributed to the success and on which could depend their applicability to other situations. Understanding of the problem and of what could be expected from public health action differed considerably between the various groups, e.g., between physicians who dealt with endemic malaria in the poor rural communities of southern Europe, army officers who had succeeded in protecting the Allied army in the Dardanelles in the First World War, colonial medical officers who ensured the health of European settlers, missionaries in tropical rural areas, public health officers assigned to major economic development projects in malarious areas (like the Tennessee Valley in the USA, the Panama Canal, rubber plantations in Malaysia, tea plantations in India, or the mines in east or southern Africa), and the international health officers planning large control projects like those for the eradication of *Anopheles gambiae* in Brazil or Egypt.

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Diverse opinions and controversies separated the sceptics from the enthusiasts who believed in the power of the available control tools. Faith in the total eradication of infectious diseases had grown out of various speculations, e.g., Pasteur's idea that it was within the power of man to rid himself of every parasitic disease, or C.V. Chapin's declaration (in 1888) that any disease that could be prevented in part could be prevented in its entirety (30), or the statement that elimination of a disease from a limited area was a practical lesson whose benefits could be extended indefinitely (28). A plea and a plan for malaria eradication in the Western hemisphere was presented in 1916 (18) but malarologists, particularly in Europe, were mainly sceptical. Thus, in its second general report (23) the Malaria Commission of the League of Nations (in 1927) concluded that the knowledge of the transmission of malaria by mosquitoes had not helped in controlling the disease and that the feasible approach at the time was to strengthen the private and public health sector in order to reduce mortality and the duration and severity of the disease, considering that malaria was impregnable to frontal attacks but would eventually succumb after improvements in the social condition of the people in malarious areas.

Even before the founding of WHO, increased attention was paid to the malaria problem by:
- the Pan American Health Organization (PAHO), which, at the III International Sanitary Conference in 1907, recommended to Member governments a wide distribution of information on malaria, free distribution of quinine to the poor, inclusion of malaria in the reports of the Port Health Authorities, and exemption from taxation of all products used in the prevention and treatment of the disease; in addition, malaria was put on the agenda of all subsequent Pan American Sanitary Conferences;
- the X Pan American Sanitary Conference, which in 1938 established the Pan American Malaria Commission to study the epidemiology of the disease, its chemotherapy, vector control, legislation and specific terminology; the three reports of the Commission (in 1942, 1944 and 1947) thoroughly covered the epidemiology and control of malaria in the Americas;
- the Health Organization of the League of Nations, which established in 1923 a Malaria Commission whose first report was delivered in 1924. From the beginning the Commission, which had enlisted the collaboration of prominent malarologists from many countries, was concerned with the development of a programme based mainly on the organization of training courses in malariology, supported by other forms of training, and the organization of international inspection tours by competent malarologists to study local problems and advise on effective measures for their solution. The Commission's efforts to improve the therapy of malaria infections and to stimulate the production of plasmodicial drugs have been recognized as its most outstanding contributions on a global scale (2).

The standardization of the use of Paris green as a chemical, of Gambusta fish as a biological larvicide, and of pyrethrum as an adulticide consolidated the antimalarial armamentarium in the 1930s, while the discovery that the main European malaria vector, A. maculipennis, was actually a complex of sibling species, which could be identified, solved the problem of "anophelism without malaria" which had been one of the main obstacles for accepting mosquito control as the general basis for large-scale malaria control in Europe.

Activities through WHO
First period: malaria control (1946–54)

The Interim Commission of the World Health Organization emphasized the importance of the malaria problem, which they considered was directly related to the world food shortage and interfering with industrial and agricultural development. The Commission therefore established an Expert Committee on Malaria which met in 1947 and again in 1948, shortly after the official creation of the World Health Organization (on 7 April 1948).

The first report of the Expert Committee shows the impact of recent scientific and technical developments. For example, the discovery of the erythrocytic cycle of the plasmodia filled a gap in the understanding of the biology of the parasite, and the effectiveness of synthetic insecticides and new antimalarial drugs raised "hopes of the complete eradication of the disease—and even of anopheles—from entire countries" (32). The Committee, however, was aware of the possible ecological dangers in the use of DDT and, being concerned about the problems of feasibility and cost, warned that "now that the emergencies of the war are over, the World Health Organization Interim Commission should not support routine programmes to control malaria by DDT which would be out of financial reach by the health authorities of the aided countries" (32).

The second report of the Expert Committee (33) outlined a "malaria policy of WHO" with the fundamental purpose of assisting governments to accomplish effective malaria control along modern scientific lines. This policy required the establishment on a permanent basis of a malaria control organization. Drawing heavily from the experience in the USA, India, Argentina, Venezuela and Brazil, the
Committee recommended that each such organization should be an integral part of the central and provincial health services but subject to considerable modification in order to meet the needs of widely differing local conditions. Great emphasis was placed on the organization of international and national training programmes, the provision of technical manuals, and the education of the public.

The Committee also emphasized the use of DDT as indoor residual spray but recognized the existence of doubts about its effectiveness against A. gambiae in Africa. It also warned against the danger of overdosing in outdoor spraying (either by aircraft or by ground aerosol or fog-spraying machines) which could result in the destruction of beneficial insects and wild life, such warning also extending to the use of DDT as a larvicide.

The great expectations placed on malaria control were endorsed by the US Secretary of State, George Marshall, who in 1948 at the opening session of the Fourth International Congress on Tropical Medicine and Malaria in Washington, DC, declared that the conquest of diseases, which hold millions weak and inefficient, and the maximum production of foodstuffs in lands now yielding little were tremendously important requirements of the world situation (24).

In 1948 the first World Health Assembly of the newly created World Health Organization accepted the antimalarial programme proposed by the Interim Commission, set up a section on malaria within the Secretariat, and requested the Executive Board to consider the establishment of antimalarial programmes paying particular attention not only to the extensive use of insecticides but also to the registration and treatment of cases, improvements in agricultural practices and housing, and support for scientific research.

The third report of the Expert Committee (34) expressed disappointment that, although the effectiveness of insecticides that had been developed since 1940 continued to be demonstrated with numerous additional examples of successful applications every year, the great need for establishing effective governmental antimalarial organizations and for overcoming the critical shortages of trained personnel remained almost unchanged. The Committee insisted on the need to train spraying personnel in the use of precautionary measures to prevent contamination and analysed the possible limitations of malaria control by residual insecticides which might include areas where the persons to be protected generally sleep outdoors, where the mosquito vector habitually bites outdoors (or though biting indoors, does not rest indoors), or where the surfaces sprayed are subject to frequent renovation or whitewashing (34).

The fourth and fifth reports of the Expert Committee readjusted the malaria policy of WHO, stating the basic principles of malaria control and the role of WHO technical assistance. An important issue under discussion was the role of malaria control in relation to other health problems. In the fourth report (35) the Committee, insisting that in highly malarious underdeveloped areas malaria control should be given the highest priority, endorsed the following recommendation of the Inter-governmental Conference of Far Eastern Countries on Rural Hygiene (held 14 years earlier): "in those areas where malaria is the outstanding social and health problem, the resources of the health administration, specially augmented where necessary, should be directed chiefly towards malaria control, even if this should entail the restriction of other public health activities, until malaria is no longer of major importance" (35) Nevertheless, the fifth report (36), while advocating that malaria control or the application of other public health techniques should not be delayed for fear of increasing the population (which should be countered by other methods), recognized that the antimalaria and other health measures, although essential, were not sufficient for balanced progress including the agricultural, social and other fields. The Committee considered this to be another reason for encouraging the coordination of malaria control programmes in other areas of development.

Evidence of the failures to obtain effective control with residual insecticides was reported, e.g., the disappointing results in some areas of Africa and the Philippines, as well as the excitant effect on vectors of DDT in Africa and BHC (benzene hexachloride) in Malaysia (33). In the fifth report (36) the Committee discussed the unsuitability of indoor residual spraying of insecticides to control Kerteszia species in some areas and noted that acquired resistance had been reported in A. quadrivittatus in the USA and A. sacharovi in Greece, and that evasive behaviour had been observed in A. albimanus in Panama. Reports were also received of the inactivation of insecticides by mud walls, in some cases by the phenomenon of adsorption and in others by the decomposition of the insecticide by iron compounds in the wall. While the Committee considered that these instances should not deter governments from embarking on malaria control, it urged vigilance and appropriate study of the phenomena involved. The Committee also warned that preoccupation with the efficacy of residual insecticides could detract from employment of other methods in particular circumstances (36). Great care was needed in the use of DDT (to avoid contamination of food and cooking utensils) and in the experimental use of new...
insecticides that had not yet been shown to be free from danger to man and animals (25).

Countries were realizing that their malaria reservoirs had disappeared after complete interruption of malaria transmission for a number of years. Insecticide spraying had therefore been terminated in areas of the USA, Greece and British Guiana. The National Malaria Society of the USA appointed a Committee on Criteria to determine when malaria ceases to be an endemic disease and these criteria for malaria eradication were adopted by the WHO Expert Committee (36), which recommended that an adequate scheme of close continuous observation to detect cases and of entomological survey should be instituted, that clinical disease should be made compulsorily notifiable, that decentralized laboratory facilities should be provided on a sufficient scale to undertake routine surveys and to make rapid examination of blood smears from any suspected cases, and that an emergency organization supplied with insecticides and drugs should be established to undertake control in appropriate areas around any detected cases.

**Second period: malaria eradication (1955–69)**

The achievement of malaria eradication by some countries and over extensive areas in the tropics gave considerable impetus to the idea of eradication. In fact, the XIV Pan American Sanitary Conference, meeting in Santiago (Chile) in 1954, adopted a continental plan for the eradication of malaria from the Americas, based on the recognized effectiveness of DDT, the existence of important antimalarial organizations in most American countries, the long-term savings expected from eradication compared with continued expenditure for control, and the risk of insecticide resistance in vectors if control activities were maintained for long periods. At that time the Pan American Health Organization had the responsibility for coordinating three other continental programmes for the eradication of Aedes aegypti (adopted in 1947), yaws (adopted in 1949), and smallpox (adopted in 1950). In 1954, the Second Asian Malaria Conference meeting in Baguio (Philippines) also recommended that the ultimate goal of nationwide malaria control programmes should be eradication of the disease (37).

The following year, 1955, the WHO Executive Board recommended the policy of malaria eradication to the Eighth World Health Assembly. The same year the Executive Board of UNICEF accepted the recommendation of the Joint WHO/UNICEF Committee on Health Policy that national and regional malaria eradication projects should be supported and that malaria control plans should be converted as soon as possible into eradication plans, and changed its policy accordingly.

In May 1955 the Eighth World Health Assembly, meeting in Mexico City, decided that the World Health Organization should take the initiative to provide technical advice and encourage research and coordination of resources in the implementation of a programme whose ultimate objective was worldwide eradication of malaria. The Assembly authorized the Director-General to obtain financial contributions for malaria eradication from governmental and private sources and established a Malaria Eradication Special Account.

The sixth report of the Expert Committee (38) defined malaria eradication as “the ending of the transmission of malaria and the elimination of the reservoir of infective cases in a campaign limited in time and carried to such a degree of perfection that, when it comes to an end, there is no resumption of transmission.” The desirability of eradication over control, in the Committee’s view, was justified by the social and economic value of eradication, the cost of which would represent a capital investment needing funds for only a limited time, and by the fear that insecticide resistance might impair the maintenance of control by means of residual insecticides.

The Committee compared the principles of eradication and of control, among which the following had important consequences on the organization of antimalarial programmes and were later responsible for many of the problems in changing from eradication back to control programmes:

(a) integration with other insect control programmes was not always feasible in an eradication programme because of the specific well-defined objective that had to be attained within a limited time, while in control programmes such integration was desirable and often feasible;

(b) case-finding and parasitological verification of suspected cases were of paramount importance for eradication but not for control;

(c) the epidemiological investigation of individual cases increased in importance and became essential as eradication was approached, but this was of little value in a control programme.

Great emphasis was placed on the urgent need for exceptionally good organization and planning outside the routine work of health departments. The feasibility of eradication was seen as depending on good management, methods and money, and malariologists were cautioned about yielding to the attractions of technology while neglecting the managerial and financial aspects.

The impact of the World Health Assembly’s decision and of the report of the Expert Committee was rapid and intense. Soon most countries in the
Americas, Europe, North Africa, Asia and the Pacific officially declared their antimalaria programmes as eradication campaigns. In retrospect it is easy to see that these programmes lacked many of the requirements of epidemiological knowledge and administrative organization which were overlooked because of the humanitarian appeal and urgency, and the feeling that peer pressures could eventually shake the chronic apathy of the health services.

There was a conflict between justification of the programme as a race against the development of insecticide resistance on the one hand, and, on the other, the need for careful planning (based on adequate knowledge of local epidemiology and ecological and social conditions) and a highly efficient organization to carry out the programme, which were clearly beyond the capabilities of most of the highly endemic countries. A solution was sought in oversimplification and standardization, despite the warning by the Expert Committee that there could be no rigid acceptance of details of procedure, because even small differences in the epidemiology of the disease might well make a great difference to the ease or difficulty of eradication and to the nature of the needed surveillance and emergency services (38). The operational aspects of the programmes were emphasized while the ability to identify and solve problems was often neglected. Preliminary epidemiological studies were reduced to the delimitation of malarious areas, which often were regarded as those below the highest altitude level at which malaria transmission had been reported; all such areas were included in the spraying programme, without distinction of levels of endemicity or understanding of their epidemic potential, or even the risk of P. falciparum as distinct from exclusively P. vivax areas. The earlier neglect of epidemiology could not be corrected even after discussion (in the Committee’s eighth report (40)) of the effect of uneven epidemiological conditions on the planning of the phases of the programme and has hampered the later adoption of stratification for planning control activities.

WHO provided technical assistance to countries to prepare comprehensive plans of operations for the expected duration of the eradication programme and established international malaria eradication training centres for senior professional staff. Most national staff were nevertheless trained in their own countries, often at special WHO-assisted training centres. The Organization also tried to coordinate the policies of the international assistance agencies collaborating in the programme, i.e., UNICEF, USAID, and the U.S. Public Health Service, and to promote and support applied and fundamental research for the eradication programme. These efforts, although successful in establishing a global programme for the evaluation and testing of new insecticides (16, 56), could not prevent a backslide. To quote McGregor (25), “throughout the world support for further research into malaria, even that concerned with insecticides and chemotherapeutics, contracted swiftly. Worse still, the apparently imminent demise of a once important disease removed the necessity for training scientists in malariology. It took 10 more years and a war to halt this tragic trend”.

Tropical Africa and some areas of south-east Asia posed difficult problems: not only did they contain the highest levels of endemicity, but also areas inhabited by populations with primitive tribal organizations incapable of supporting complex administrative structures and high costs of malaria eradication campaigns. Pilot projects were organized and conducted by governments with the assistance of WHO and local interruption of transmission was reported in some forest areas (in Liberia and Cameroon (21)) and in areas of meso- or hyper-endemicity due to higher altitude (in Uganda (11)); such success was not possible in the savannah areas, although great reductions in parasite rates were obtained in various projects (in Sokoto (6, 8), Pare Taveta, and Kankiya (74)). In countries where pilot projects had been successful it was impossible to expand the antimalaria activities, which were eventually discontinued even in the pilot project areas.

Successes elsewhere, although slower than anticipated, were remarkable. Nevertheless, as more and more areas advanced into the consolidation phase of the programme, the expectation that a surveillance mechanism would be able to maintain the areas malaria-free, after interruption of spraying, was not fulfilled.

More and more demands were put on the Expert Committee to define appropriate surveillance structures and methods but, while at the time of planning malaria eradication there were more than 10 years’ experience in the use of DDT for malaria control, there was only indirect evidence and theoretical considerations on which to base the guidelines for surveillance of malaria in the last stages of

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the eradication process. This development illustrates the conflict between the demands for simple technical standards for managing a large operational campaign and the efforts of the Expert Committee in their seventh to twelfth reports (39–44) to extract from very meagre observations some guidelines of general applicability, with the result that even if guidelines were presented only as tentative and in need of local validation, they soon became universal operational standards along which the services were organized.

A very unfortunate consequence of these developments was the neglect of the problem of malaria as a disease. The hope of rapidly achieving the total elimination of the parasite plus the need of the programme to identify all remaining malaria cases, led to the progressive take-over by the malaria surveillance mechanism of the management of fever cases from the general health services. The management of such cases, most often in the hands of auxiliary personnel with very limited training, was aimed at the detection of malaria parasites and not necessarily at the treatment of the disease condition. All fevers were treated as presumptive malaria cases and given a single dose of antimalaria treatment; a blood film was also taken and when the result was available, often several weeks later, a search was made for the positive cases, who were given radical treatment for their infection. A malaria case thus became equivalent to a positive blood film so that the medical services lost interest in the disease and any attempt to study the epidemiology of malaria as a disease was abandoned in most places.

The problems of resistance to insecticides and the evasive behaviour of vectors became more widespread and evolved more rapidly than expected. Parasite resistance to antimalarial drugs was also recognized, although during the 1960s resistance to chloroquine seemed to be restricted to the northern parts of South America and to the Indochina peninsula.

Since the early 1960s, some areas were identified where interruption of transmission could not be achieved with apparently correct application of the attack methods. The eighth report (40) recognized some causes of technical failure in some programmes, such as exophily or resistance of vectors, population movements, sorption of insecticides by some wall materials, resistance to drugs, and toxicity of dieldrin (used in some programmes), but expected that such problems, deemed of local importance, could be solved with the available attack methodologies. Soon it became clear that the complexity of the problems was much greater and the concept of "problem areas" (12, 42, 43, 45) gained currency; such areas, which soon multiplied in the Americas and Asia, required careful study of the underlying problems and a search for innovative solutions. They included tribal areas with populations dispersed over extensive territories, areas of new agriculture exploitation, areas of extensive use of agricultural pesticides leading to multiresistance of malaria vectors, border areas, and areas of sociopolitical disturbances.

Resurgences were occurring more and more frequently in areas in the consolidation and maintenance phases, particularly in Central America and south-east Asia, culminating at the end of the decade with a massive epidemic in Sri Lanka, where malaria had almost been eradicated (5). Resurgences were in most cases attributed to the inability of the general health services to maintain malaria under control and led to the re-establishment of the attack phase in full force which, in most cases, controlled the situation but did not contribute to a better understanding of the epidemiological dynamics on which to plan an improvement of the health services to cope with future problems.

Progressively throughout the 1960s a feeling was developing that the malaria eradication global programme could not succeed in the foreseeable future. The eighth report of the Expert Committee already made a detailed analysis of the causes of failure (40). Many later analyses were made of the causes of this failure from the perspective of malariologists (e.g., Bruce-Chwatt (3, 4, 6), Farid (13), Lopes (20) and Ray (27)) and of general public health (9, 22, 31).

Evidence started to accumulate that, although it was possible to reduce and even interrupt malaria transmission by insecticide spraying in large areas, it was very difficult, if not impossible, to establish effective surveillance in the absence of a solid health infrastructure (15), which was lacking in the majority of endemic countries. In 1962 the Fifteenth World Health Assembly (resolution WHA15.19) had urged governments with malaria eradication programmes in operation to ensure active participation of the health services, particularly in the epidemiological activities (49). The Expert Committee made an attempt to promote in countries that lacked an adequate health infrastructure, before planning an eradication campaign, "a parallel correlated development of rural health services to assure the effective implementation of the consolidation and maintenance phases of the future malaria eradication programme" (40). This development of a pre-eradication programme never succeeded in spite of repeated support by the WHO Executive Board and the Health Assembly after 1962 (e.g., resolution WHA16.23 and WHA18.3).

The problems encountered in extending the eradication beyond the areas of early success, plus
the re-examination of some of those experiences led to some serious doubts on the basic principles of eradication, such as the following:

- A contrast was obvious between the frequency of resurgence in countries where eradication had been obtained before 1955 and the new vertical programme. Attention was called to the conclusion, drawn already in the 1950s, that at least in the USA malaria had disappeared as an endemic disease from the South, probably before the DDT programme had got under way (1, 19). Thus, and the failure of the proposed surveillance system, suggested a flaw in the definition of malaria eradication, as eradication required something more than the total elimination of the reservoir, unless taken on a global scale.

- The basic principle of the economic advantage of eradication was put in doubt not only because of the progressive realization of the high cost of surveillance but also by the fact that this advantage had been postulated without taking into consideration the principle of discounting the present value of future expenditures (70).

The thirteenth and fourteenth reports of the Expert Committee (45, 46) reviewed the main factors affecting the progress of malaria eradication, and very often found serious deficiencies in planning, administration and finance, training and personnel, and the conduct of operations. The fourteenth report concentrated on the study and solution of technical problems and the definition of prerequisites for starting malaria eradication programmes (46).

**Third period: malaria control with the ultimate goal of eradication (1969–78)**

Following a re-examination of the global strategy of malaria eradication, which was recommended in 1967, the World Health Assembly, while reaffirming that complete eradication was the ultimate goal, recognized that in the regions where eradication did not yet seem feasible, control of malaria with the means available should be encouraged and regarded as a necessary and valid step towards that goal (47).

Most antimalarial programmes, with the collaboration of WHO, PAHO and other agencies such as UNICEF and USAID, were evaluated by multidisciplinary teams in order to decide whether the programme had the capacity to achieve eradication in a foreseeable short term; and if not, it was considered as a malaria control programme. It is possible now, with the benefit of hindsight, to see that such teams were subjected to numerous pressures and that their conclusions were influenced by the interest of many programmes in maintaining their organization and autonomy, an attitude which in many cases was supported by the health authorities fearful of the labour problems that could arise from the interruption of routine field operations.

Perhaps an even more serious problem was the fact that the concept of malaria control and an acceptable strategy for it remained undefined. When many programmes were faced with the realization that they would not be able to achieve eradication, it was assumed that their transformation into control programmes was an automatic result of the declaration of the change in the stated goal. Somehow it was not realized that the structures that had been designed to carry out activities considered essential for eradication but of little value in control programmes were not only wasteful but were actually consuming most of the limited human and material resources of the programme. Few programmes recognized the need to plan control activities de novo, fixing attainable objectives and selecting appropriate approaches to the local situation and to the solution of the identified problems (26); and even fewer programmes, if any, changed their approach from the mere performance of some selected routine interventions to incorporate a capacity for problem identification and problem solving.

Moreover, the recognition that global malaria eradication may not be attainable in a programmable future weakened the claim that eradication was a capital investment and not a recurrent expenditure and led to the withdrawal of financial support for many programmes by UNICEF, USAID and some other collaborating agencies. At the same time the increases in the cost of insecticides and transport in the 1970s resulted in serious cuts in the operational capacity of programmes, poor performance and lowered morale.

These developments led to a further polarization between malarialogists who felt abandoned and public health administrators. It may be noted that the Expert Committee meeting in 1970, in lieu of providing technical guidance on control approaches and methods, reaffirmed the principles and reviewed the practices of malaria eradication and, while recognizing the need for malaria control in some areas, emphasized that the great gains made by eradication in many parts of the world would continue to be threatened if large areas remained with little alteration in endemicity (48). The guidance provided by this and the sixteenth report, devoted to malaria control (50), on how to transform an ineffective malaria eradication programme into a control programme was sketchy and dominated by the postulate that “the objectives in these areas would be to consolidate the gains so far achieved, to extend the programme to areas where protection would give maximum socioeconomic benefit and to protect high
risk groups" (50). Unfortunately most countries considered that the only way of consolidating the gains so far achieved was to maintain as much of the current routine activities as they could afford.

During the decade several countries attempted integration of partially effective malaria eradication programmes into poorly developed basic health services. Some of them were followed by deteriorations in the malaria situation and a return to the vertical approach to malaria control.

**Fourth period: malaria control as part of primary health care (after 1978)**

While the antimalaria programmes were facing all the above-mentioned difficulties, the efforts to establish basic health services were not more successful and were incapable of achieving sustainable coverage in the peripheral areas of developing countries. It may be that these efforts, like those for malaria eradication, were aimed at (1) promoting the adoption by the developing countries of rationalized models based on the experience of the developed countries and (2) focusing attention on technical questions, assuming that questions of acceptability or politico-administrative feasibility were merely operational or administrative problems to be solved during the implementation of the programme, but which should not influence the basic design.

The formulation in 1978 of the primary health care strategy for the development of the health infrastructure required the formulation of malaria control based on that infrastructure (51). In line with these developments, the Thirty-first World Health Assembly adopted a strategy for malaria control aiming at least at the reduction of mortality and of the negative social and economic effects of the disease, the prevention or control of epidemics, and the protection of malaria-free areas, with the ultimate objective of eradicating the disease whenever feasible. The selection of control methods should be made following what has been defined as the epidemiological approach in its broadest sense, i.e., taking the fullest possible consideration of the biological, ecological, social and economic determinants of the malaria problem and those factors which may influence the applicability or effectiveness of individual control measures and their possible combinations. A fundamental element of the strategy is the recognition of the variability of epidemiological situations, the feasibility of their modification and the availability of resources, and therefore of the need to adapt malaria control planning to local conditions. As an example of such variability four tactical variants were considered with objectives of increasing complexity, from reduction of specific mortality and reduction of severity of the disease (variant I) up to complete eradication (variant IV).

In 1975 a Special Programme for Research and Training in Tropical Diseases (TDR) was established jointly by the UNDP, the World Bank and WHO. The main purpose of this programme was the search for new or improved tools for disease control and the development of research capabilities in endemic countries. In malaria it gave special priority to chemotherapy, immunology and field research needed for operationalization of new tools, the better understanding of epidemiological and control problems, and the search for their solution. Besides its specific malaria component, very important contributions have been made by the social and economic research, the biological vector control and the epidemiological components of the programme.

The seventeenth report of the Expert Committee (52) developed the concept of control, based on the four tactical variants, to illustrate possible interventions. The tactical variants were rapidly accepted as a way to describe programmes; particularly attractive was the fact that for the first time since the formulation of the malaria eradication strategy in 1956, a practical option was presented for malaria control in tropical Africa. Unfortunately such tactical variants, in lieu of being considered as examples of a much wider variability became operational prototypes to which programmes tried to adjust and, as it would be expected, often not succeeding.

**Recent evolution of the problem**

The evolution of the malaria problem has been traditionally described in terms of the number of registered cases reported to WHO by Member States. Such information is reported every year in the *Weekly epidemiological record*, and has been analysed for the last forty years in the *World Health Statistics Quarterly*. Fig. 1, taken from the latter (53), shows the evolution from 1964 to 1985, which corresponds to the period of maximum impact of the eradication campaign. It excludes information from Africa owing to the insufficiency and irregularity of reporting, but shows the impact of the massive resurgence of transmission in India in 1976 and its subsequent control. The evolution in China is shown separately as official reporting to WHO started only in 1977. It is worth noting that this country did not implement a national malaria control programme until it achieved the development of an effective peripheral health infrastructure, which has been considered as one of the precursors of the concept of

*Malaria control strategy Report by the Director-General (unpublished WHO document A31/19, 1978)*

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primary health care; the pattern of reduction in malaria incidence is similar to that observed in countries which achieved eradication. Fig. 1 also shows that, if India and China are excluded, the rest of the world shows a general stagnation in the last fifteen years and that India, after the recovery from the 1976 epidemic, is apparently getting into a similar situation of stagnation.

If that general picture were disaggregated for individual countries, it would show that many of them have had periodic resurgences followed by remobilization of control efforts, after which the situation improved but could not be maintained and was followed by a new resurgence. This sequence, which could be described as "fire fighting", may lead to a progressive improvement of the situation in the more developed areas, as the population becomes less tolerant of the epidemic outbreaks and the health services become more responsive. In marginalized areas, the response is nearly always late and possibly ineffective as often it comes when the epidemic is naturally declining.

This general pattern also covers new problem areas, e.g., areas of agricultural exploitation or open mining in jungles, as in the Amazon basin or the new settlements in the outer islands of Indonesia, and other countries in south-east Asia, new agricultural development projects which attract large labour forces (often disorganized), areas with sociopolitical disturbances, populations engaged in illegal activities (often in border areas), periurban settlements of explosive growth and, in general, most areas of weak social cohesion, where malaria tends to occur out of reach of the capacity of action of the health services. Such areas which today pose the most serious problems to malaria control are basically the same types as the problem areas in the 1960s: moreover, the recent global economic crisis and the improvement in transport facilities have helped displace more people towards these new "frontier" areas.

The conditions described above have favoured the selection of *P. falciparum* parasites resistant to antimalarial drugs, and their progressive dispersal as more and more of these drugs (often in insufficient doses) were used for prophylaxis and automedication. Fig. 2 shows the spread of this problem.
Fig. 2. Areas where chloroquine-resistant Plasmodium falciparum has been reported.
Malaria control strategy

Problems in implementation

Many of the problems which prevented the transformation of eradication into control programmes, following the resolution of the World Health Assembly in 1969, still remain unsolved. The required integration of services faces very serious problems which are due to the resistance of the antimalaria programmes to integration as well as reluctance on the part of the general health services. In short, there is need of: (a) epidemiological redefinition of the situation; (b) redistribution of resources; (c) reorientation of personnel; and (d) redistribution of responsibilities between specialized and general health services. However, none of these is easy to carry out; some of the constraints are described below.

(a) The malaria and health services staff are often unable to abandon the campaign approach and start thinking about planning an antimarial service. Partly this is due to reluctance to accept as valid any public health action not aimed directly to reduce malaria transmission.

(b) As the eradication proposal relied on its expected effectiveness, there was strong emphasis on the creation of an efficient operational mechanism for the spraying of insecticides and the collection of blood slides. In contrast, malaria control requires appropriate technical guidance from the specialized services to the general health services and the community as well as for intersectoral cooperation. More technical competence and a smaller labour force are required. For instance, the absorption, in several countries, by the general health service of all the unqualified malaria workers, who continue to do all the traditional antimarial routines, defeats the whole purpose of integration of services.

(c) The resources for microscopic diagnosis in the eradication programmes have been concentrated on the search for parasite carriers, with the aim of eventually confirming their eradication, rather than on the management of malaria as a disease. Epidemiological services were therefore designed for the elimination of the few residual or new foci that were expected to occur during the consolidation or maintenance phases and not for the detection and study of risk factors and the design of control approaches adapted to local conditions. Investigation of individual cases rather than localities was emphasized and the bulk of the human and material resources were concentrated in the areas of lesser transmission.

(d) The lack of attention to epidemiological variability in space and time has continued in most programmes, so that all epidemiological considerations are based on variations of average incidence in large administrative units, often without any particular attention being paid to \textit{P. falciparum}.

(e) The attempts at integration of malaria programmes into the general health infrastructure were mainly done as administrative decisions, without planning a redistribution of functions between specialized and general services or between the health services, other parties in intersectoral cooperation, and the community. Often decentralization and integration, instead of bringing about social control of effectiveness and efficiency, led to disorganization of services, weakening of supervision, and general decrease in the quality of work. It was therefore not uncommon that such integration of services was followed by local outbreaks, and conservative malarologists used to press for the restoration of the vertical programme. In addition, the efforts in primary health care, competing with vertical programmes for financial resources and political influence, are often limited to some expansion of curative services at the periphery, and the need for epidemiological services and the potential contribution of specialized programmes are ignored.

Although these influences on the programmes differed in each case, the most common result was a tendency for programmes to lose their dynamism while financially committed to employing large labour forces at the periphery; the constant increase in the proportion of the budget devoted to payment of personnel, especially in the lower technical echelons, led to a progressive attrition of operational capabilities and competent professional guidance. While established routines continued in the best organized areas of countries, which are commonly the least malarious, there were few or no human or material resources left for the poorer areas or in the frontier zones where the malaria problem was reaching dramatic proportions.

Present approaches

In 1985 the Thirty-eighth World Health Assembly recommended an urgent review of the malaria situation and current control activities in each endemic country, in terms of their effectiveness as well as feasibility in sustaining the level of control which may be achieved. Following the recommendations of the Assembly the Expert Committee, in its eighteenth report (54), analysed the global epidemiological situation and the problems of application of the control strategy as defined in 1978. The Committee also developed the epidemiological approach for the design of control interventions, an essential element of which was recognition of the variability of local
epidemiological situations. This variability, although due to a multitude of factors, could be studied in relation to the potential effectiveness and sustainability of available interventions, thus permitting the recognition of a limited number of types of situations characterized by predominantly demographic, parasitological, entomological, ecological, or social and politico-administrative factors. Identification of the geographical distribution of these types of malaria problems constitutes the so-called "stratification", which is the basis on which to select appropriate interventions.

There are two fundamental objectives in any antimalaria action:

(1) The first is to provide the whole population in malarious areas with easily accessible appropriate diagnostic and treatment facilities for malaria as a disease. This is the minimum response to the basic demands of the population, as part of the efforts of the health sector to improve the peripheral management of disease problems by providing basic diagnostic and treatment facilities at the community level and increasing their utilization by improving people's perceptions of health, disease and treatment opportunities. Past experience has shown that it is possible to train lay personnel in the recognition of the main causes of fever and the administration of basic treatment for malaria, diarrhoea and acute respiratory infections. It is recognized that such community services could develop into more advanced and useful systems of medical care if they are properly supported by a referral system that included dispensaries and hospitals to receive and care for severe cases from the periphery, and those who failed to respond to the treatment given. It is clear that the mere existence of these services cannot influence the rates of malaria incidence although they may have a great impact on the average duration of sickness, frequency of severe cases, and mortality.

These services should also promote the use of measures for individual protection against transmission, e.g., use of mosquito nets and window screening, and the organization of community action (properly guided by the health authorities) for the production and repair of mosquito nets, their impregnation with appropriate insecticides, and the elimination of breeding places of anophelines. These services should also be the base for epidemiological vigilance and monitoring of specific problems, such as the spread or intensification of parasite resistance to antimalarial drugs, and for the early detection of epidemics and eventually the identification of areas of high endemicity, where more complex interventions for curbing transmission should be introduced.

Even if at the beginning it may be necessary, in highly malarious areas, for the community services to concentrate only on the diagnosis and treatment of malaria (as with the antimalaria dispensaries in southern Europe before the Second World War, malaria voluntary collaborators in many antimalarial programmes in the Americas and Asia, and the antimalarial clinics in Thailand), their usefulness in the future will depend on their integration into the health infrastructure and their capacity of evolving into or complementing broader medical care services. Thus, there is no one model to follow, experience being limited to certain areas and to only some aspects of the process. One must adopt a "learning by doing" approach with documentation and exchange of experiences to explore, for example, the best ways of training, supervising and supporting the work of lay personnel, guiding and controlling private medical and paramedical practice, and marketing antimalarial drugs.

(2) The second objective is the control or interruption of malaria transmission. Many people consider that this is the only true malaria control. There is no doubt that the interruption of transmission would finally eliminate the need for extensive peripheral services aiming at the diagnosis and treatment of malaria, but many countries have experienced the disappointment that, after considerable expenditure for many years in attempting to interrupt transmission, massive resurgences of the disease have occurred, and they find themselves with very inappropriate services for coping with the disease. Such dramatic situations in most instances lead to renewal of the efforts for controlling transmission, often with new insecticides, or the introduction of more expensive methods of application, such as space spraying, which again reduce transmission considerably but cannot maintain it because of the financial effort required or because of progressive loss of effectiveness owing to operational problems, development of resistance, or reduced acceptability by the population. Such transformation of an originally endemic situation into a sequence of periodic epidemics is totally unacceptable not only because of the overall waste of resources it represents, but above all because in most cases it represents a greater toll to the community in terms of disease and death than the original endemic situation.

As mentioned above, activities to control transmission should be guided by the epidemiological services, whose abilities should be developed for the early detection and eventually prediction of epidemic situations, and for the identification of areas of intense endemicity or those where a high density of population or socioeconomic development may ensure the feasibility and sustainability of these control activities.

Antimalarial measures have been the object of
numerous classifications, malarologists mostly basing theirs on the link in the chain of transmission being affected. For example, Bruce-Chwatt (7) considers the following types of control:

(a) individual protection (such as house site selection and screening, bed nets, and repellents) aiming at reduction of man–vector contact;

(b) vector control, which in turn may aim at (i) reduction of vector breeding habitats by environmental modification or manipulation, (ii) reduction of vector densities by chemical and biological larvicides or by insecticide space-spraying, and (iii) reduction of longevity of the vector population by residual insecticide spraying; and

(c) antiplasmodial measures (such as treatment of cases, chemoprophylaxis, and antirelapse treatment) aiming at the elimination of malaria parasites.

Public health planners may be more interested in identifying the interventions that require a specialized service, which ones should be performed by the general health or medical care services, or require the mobilization of intersectoral collaboration, and which ones should be performed by the individual, the family and the community (53), paying particular attention to what is now being done about the problem at all these levels and how each can be stimulated, helped and supported to do better.

The planning of malaria control should take into consideration all these possible approaches, depending on the individual situation. In this regard, the advice given in 1937 by Hackett (17) remains valid: “there is no objection at all to using any combination of these methods which seems expedient and within one’s means. The objectionable thing is the shotgun method of applying them indiscriminately without knowing how far the cost of each is justified by results under local conditions. It is not rare to find inexperienced people attempting everything badly and accomplishing nothing . . . No method of control is economical which costs more than it is worth, or which is unnecessary to secure the desired end . . . The general strategy of the attack on malaria is subject to an adaptation to local circumstances and an opportunism beyond that required by any other major disease of mankind . . . and like chess it is played with a few pieces, but is capable of an infinite variety of situations”.

The application of these principles to new malaria control programmes is relatively straightforward, but the present situation in most malarious areas outside tropical Africa is not one of planning anew, but of transforming existing programmes. In fact, the 5000 million people in the world may be classified as follows, according to their malaria experience and residence in areas where:

(a) malaria never existed or disappeared without specific antimalarial interventions—27.4%;

(b) endemic malaria disappeared after a specific control campaign was implemented and the malaria-free situation has been maintained—28.0%;

(c) endemic malaria was considerably reduced or even eliminated after control measures were implemented but transmission returned and the situation is unstable or slowly deteriorating—34.9%;

(d) endemic malaria remains basically unchanged and no national antimalaria programme was ever implemented (mainly in tropical Africa)—8.6% (even this category is far from being uniform; there are areas where pilot projects reportedly were successful in interrupting malaria transmission, which included forested and medium-altitude areas while in low-altitude savannah areas, particularly in the Sahel, no full success was even reported from pilot projects);

(e) areas where new problems have arisen following major ecological or social changes, such as agricultural or other exploitations of jungle areas and places of sociopolitical unrest—1.1% of the world population.

It is obvious that malaria control in each of these areas must differ, but for the selection of objectives and approaches it is even more important to consider the state of development of primary health care and the situation in the control of other parasitic or vector-borne diseases. Replanning malaria control is not simply a technical problem: the existing antimalaria organization may serve as a base to create general epidemiological services, but it is necessary to ensure that the health infrastructure maintains a core of epidemiological competence to plan appropriate control interventions, to train and reorient the health and medical services to improve their performance, and to guide the health education of the population. Changing the objectives should not mean necessarily following the path described in the second report of the Malaria Commission of the League of Nations: “The history of special antimalarial campaigns is chiefly a record of exaggerated expectations followed sooner or later by disappointment and abandonment of work” (23).

Research should be supported to the fullest extent possible, taking into account that malaria research covers not only the traditional areas of chemotherapy, epidemiology, and vector control but also includes largely innovative or formerly neglected fields such as the development of vaccines and new diagnostic tools, and the elucidation of social, ecological and behavioural determinants (54).

Great expectations have been placed on the development of a malaria vaccine because an effective vaccine would certainly play an important role
in malaria control, but it should be remembered that each breakthrough in research, although at first hailed as the final solution to the problem, only contributed to better control or even the elimination of the disease in some areas or sectors of the population, but the problem itself still continued in most of the other areas. A review of past history—the discovery of the curative effect of *Cinchona*, the isolation of quinine, the discovery of the malaria parasite and its transmission by certain anopheline species, and the discovery of the residual effect of DDT and other synthetic insecticides—shows that all these led to the proposal for mass control and even the eradication of the disease.

When planning malaria control it should be possible to find inspiration in the advice of the classical malariologists of the pre-DDT era, such as Russell: “Perfection and speed in any line of human endeavor are expensive. Certainly, this is true of malaria control programs. It is probably a mistake for the tropical malariologist to strive for perfection, because the tropics are too poor to pay for it. Rather there must be constant striving for continuity of modest effort. *Time more than Money*, and *Continuity* rather than *Perfection*—these must be the mottos guiding malaria control in the tropics” (29).

And in 1937, Hackett made the following observations which are full of reality today: “Clearly governments can trust to no formulas devised in Geneva or elsewhere, but must create the simple machinery necessary to define and resolve their own problems, locality by locality”, and “The apathy of governments to the devastating effect of malaria on the population is in part due . . . to the insidious nature of the disease . . . but in my experience the inaction of governments in the field of prevention is due rather to a profound scepticism induced by lack of permanent results from previous expenditures on malaria control” (17).

In planning malaria control as part of primary health care, the latter cannot be considered as a technological option, or as a prerequisite for starting malaria control, but as the common objective of health development. As Ströde, quoted by Hackett (17), said, “we do not necessarily need a fully developed health system before attacking special problems; we often begin by attacking certain diseases in order to develop a general system”. The important thing is that whatever infrastructure is built should be capable of incorporation or transformation into a more general system.

References


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