UNITED NATIONS a 60700 NATIONS UNIES

WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTÉ

CONFERENCE ON MALARIA IN AFRICA

Lagos, Nigeria
28 November-6 December 1954

WHO/Mal/131
Lagos Conf./5
2 September 1955

ORIGINAL: FRENCH

The Chief of the Malaria Section has the honour to communicate hereunder a report on

MALARIA CONTROL IN TROPICAL AFRICA

by

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Introduction to item 7 of the Provisional Agenda

These few remarks are inspired by experience in the control of malaria over a number of years in Madagascar. They are also the result of observations made during several missions carried out on behalf of the French Government, in collaboration with a representative of WHO and of UNICEF, in the French Cameroons, in French Togoland and in French West Africa, for the purpose of establishing or inspecting malaria control demonstration areas and pilot projects in these territories.

Finally, they are the outcome of a tour undertaken on behalf of WHO in the Belgian Congo, the Union of South Africa, Mozambique, Angola, French Equatorial Africa and Portuguese Guinea for the purpose of contacting the health authorities of these different countries, and of contributing to the preparation of the second conference on malaria in Africa.

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The "control" of malaria, as it has been practised since the discovery and application of contact insecticides, has brought immense benefits to many countries which have undertaken campaigns against adult anopheles by means of the spraying of residual insecticides.

This method has often caused a spectacular regression of malaria, and in some of the more favoured countries transmission of the disease has been totally stopped by house-spraying operations alone, carried out according to strict techniques and with adequate dosage.

The frequency of the spraying and the doses of insecticides to be used were carefully studied and defined at the 1950 malaria conference at Kampala in equatorial Africa, which put forward recommendations on the subject. These doses, in so far as the gamma-isomer of BHC is concerned, were even increased after experience in the field. Nevertheless, with regard to the African continent, although the populations in the regions treated with residual insecticides have undoubtedly profited by these operations, it is not yet possible to affirm that in any given region the transmission has been definitely interrupted, even though in some cases the efforts to this end have been continued over several consecutive years.

There is therefore a certain uneasiness, a certain anxiety, concerning the value of the method in tropical Africa, and some uncertainty as to the attitude to be adopted in the coming years. Although it seems fairly easy to stop transmission and even to eradicate the vectors in the towns, there are those who begin to doubt whether in African rural surroundings the transmission can be interrupted by means of spraying with residual insecticides, and it is being asked whether the expense of these operations is really justified.

The cost of imagocide campaigns is a heavy burden on budgets, even when international assistance is forthcoming, and since transmission has not been stopped it is impossible to see an end to the expenditure.

It is certain, of course, that even if malaria is not suppressed, the house spraying operations, whether in rural or urban centres, are well worth while. Everywhere, the improvement in public health has had repercussions on vital statistics, on living standards and on economic development. Unfortunately, however, these progressive improvements are not always related to the malaria control operations which have made them possible.

Moreover, now that malaria has diminished in intensity and is no longer a major problem, many will think that the money devoted to the control of this disease could be more usefully spent elsewhere; they forget that the premature discontinuance, or even slackening, of the campaign would mean that malaria would again become aggressive and all the ground gained would be lost.

Although malariologists are aware of this, it seems less evident to governments and assemblies which vote the necessary credits and for whom malaria control is only one item among many which budgets have to meet.

The problem, already difficult for all those whose task it is to control malaria in a given territory or region, has become strangely complicated by the fear that anopheles may become resistant to the contact insecticides at present in use.

If this is true, we are faced with the possibility of being obliged one day to abandon a method on which the greatest hopes were justifiably founded, and of finding ourselves unarmed in the presence of a renewed threat until something else, better than the chlorinated insecticides, is found.

It is for this reason that on the continent of Africa there is, in connexion with the control of malaria by means of residual insecticides (which already seems an expensive method which there is no possibility of discontinuing in the foreseeable future), acute anxiety as to what the result will be if resistant vector anopheles appear before transmission has been stopped.

Fortunately, so far there do not appear to be resistant anopheles in Africa. At the most, there may be some behaviour resistance in that the vectors, and Anopheles gambiae in particular, seem to avoid alighting on surfaces covered with insecticide if they can find outside resting places, near habitations. However, on this point information is somewhat contradictory and the study of the biology of A. gambiae is far from being complete.

However that may be, the possibility of development of resistance cannot be ignored, and in order to meet this threat, modifications which are justified by observations in other continents must be introduced into the strategy adopted in the campaign against malaria.

The contact insecticides at our disposal at the present time are remarkably effective, and every effort must be made to put them to the maximum use so as to interrupt transmission before any resistance appears. The only logical aim now, in the face of this problem, is complete eradication of malaria. Obviously, eradication over the whole continent of Africa cannot be achieved at once, but in sectors where the campaign has already started, the control operations must be transformed into eradication operations by the application of appropriate and rigorous methods, and by the selection - in order to limit the sectors - of natural frontiers which will enclose the zone treated,and protect it against any possible reinfestation by man or by anopheles from outside the zone.

Whereas control would have continued indefinitely, it is to be hoped that a time limit can be fixed for eradication operations, and afterwards it will be possible for anopheles to co-exist with man without harming the latter, in a country from which malaria will have been extirpated.

Eradication will be followed by a period of surveillance and protection of frontiers until the disease has been eradicated in the neighbouring territories also.

To those who know Africa, the idea of eradication of malaria there may seem Utopian. The control operations carried out in various parts have up to the present time given only uncertain and somewhat discordant results. Malaria has certainly decreased, but in no part of Africa has transmission been interrupted.

The problem of malaria is of course more complicated in Africa than in other continents, and the house-spraying campaigns in rural areas meet with numerous difficulties which may explain the partial failures here and there.

Nevertheless, all the work, all the effort, all the money spent so far have not been wasted. The failures themselves teach useful lessons and one of the duties of the Conference is to study these failures as well as the successes, and to draw from them conclusions which will make it possible to establish the basic principles of the strategy to be adopted in the eradication of malaria in Africa - that is, to establish a programme which will enable the technicians, each in their own sectors, to work with confidence towards a common end when they have been provided with the necessary material means.

The difficulties in imagocide campaigns are common to all countries, apart from certain local variants, but many of these difficulties are more acute on the African continent than elsewhere.

In the first place, there is the question of personnel. In view of the immense size of Africa, there is an insufficiency of specialized personnel at all levels. There are too few malariologists and entomologists, so that each one is overwhelmed with work.

The most serious shortage of personnel, however, is among the categories who actually carry out the work. The supervisor at the head of each team, or group of teams working together in the bush is often the only responsible officer among the workers, and it is on his sense of duty and on his technical ability that the success of the operations depends, since the malariologist, chief of the sector, cannot control them over great distances.

A number of failures have been due to incompetence on the part of team chiefs who have been content to allow their men to use more or less satisfactory techniques without giving sufficient attention to the doses which should normally be sprayed, or ascertaining that all surfaces are covered. Obviously therefore, the greatest care must be exercised in the selection of team chiefs, and they must be given thorough training; on the other hand, they must be offered stable employment and adequate remuneration since their work is often hard and their responsibility very heavy.

There are also special problems in connexion with the insecticides in Africa. First of all there is the question of transport. It is a long way from the factory where the product is manufactured to the locality in which it is to be used. Transport is first by boat, then over land by railway or road and very often finally over long distances by tracks over which vehicles cannot pass. This all considerably increases the price of the product by the time it arrives where it is required, and supplies must be ordered well in advance in view of the possibility of delays caused by ships having to take another route, dock strikes, vehicle breakdowns, etc. Any of these factors may hold up a campaign in the midst of its activities, or even postpone the activities for long months if the rainy season intervenes and makes communication impossible.

In order to have the necessary reserves of insecticides, considerable sums have to be tied up, and there is also the problem of storing the supplies in the various centres to which they are sent. Packing and proper preservation of the insecticides are of capital importance: it must be possible to store the products away from heat and damp; they must be frequently chemically and biologically controlled to ensure that their properties are intact, it being taken for granted that in the first place the factory supplied a valid product up to the normal standard.

The immense distances in the African continent also affect the vehicles used for transport. Apart from the distances to be covered, the state of the roads over which they have to pass damages the vehicles and their life is consequently short; frequent repairs are necessary, and this demands a stock of spare parts and even of spare vehicles if the work is not to be held up.

Mechanics are also rare and often not very highly qualified, and this causes serious trouble if a region has to be treated, for example, before the onset of the increase in the anopheline population which coincides with the annual transmission period.

Another inconvenient factor which affects both transport and spraying operations is the shortage of water over vast regions in the dry season, whereas in the rainy season in these same regions the communication routes are cut on account of floods. During a campaign, therefore, it is necessary to transport not only personnel and insecticides, but also the water necessary for the suspensions or emulsions - which means that extra trucks or tank vehicles must be bought, thus increasing costs.

All these material difficulties are of themselves sufficient to compromise the results of a campaign. The remedy is simple and at the same time difficult, for it is entirely a question of money.

There are other difficulties, however, which may be called technical and which are less easily overcome. These difficulties are due on the one hand to the differing habits of the various African populations, and on the other to the biology of the vectors.

African populations are essentially rural, and apart from certain relatively prosperous regions where there is a sufficient population density, the people are widely scattered in small villages consisting of a few houses only, and often difficult of access. This complicates the house-spraying operations, slows them down, and considerably increases the cost per inhabitant protected - the more so since the ratio between surfaces treated and extent of breeding places is very unfavourable and calls for strict adherence to the technical rules.

In addition, the habit of constantly reconstructing the straw huts, of changing their roofs, or replastering the walls of them in certain seasons, or of completely moving the whole village, considerably complicates the operations. A well-planned campaign must bear in mind all these factors and allow for sufficient flexibility so that methods can be adapted to particular circumstances. The nature of the various surfaces and their ability to absorb the insecticides must also be considered.

Population movements constitute another obstacle. Although many of the people are sedentary and move about only within a limited area, there are also nomadic tribes which move in search of pasture for their animals, who travel for purposes of trading, or who migrate en masse in certain periods of the year to work in other under-populated areas which require agricultural and mine workers.

It is evident that a transfer of inhabitants from a non-protected to a protected area will falsify the results which may justifiably be expected from a well-conducted campaign unless infected persons are treated on their entry into a protected area. This is what happens, in fact, on a smaller scale, in a pilot or experimental zone when it is too small. In this connexion there arises the question of the role which antimalarials can play in an eradication campaign until malaria control has been developed on a continental level. It will be seen also that it is essential to establish natural frontiers around sectors in which eradication campaigns are proceeding, so that an effective system of surveillance may be established.

Another difficulty arises also among the sedentary peoples in many regions in Africa: in the harvest season some of the people leave the village and install

themselves in temporary shacks in order to keep watch over the fields day and night. These shacks usually consist of a roof supported on posts, without any walls. The inhabitants who stay in the village also often pass part of the night in the open, thus exposing themselves to the danger of being bitten by mosquitos.

These habits undoubetdly constitute the most serious obstacle to eradication of malaria in Africa and, in fact, it is on account of these factors that it will very probably be impossible to achieve that end in many regions by house spraying alone.

Although some of the failures in the various experimental zones have no doubt been due to obvious technical defects, it may be said that in most cases the results were uneven in spite of accurately carried out operations with good quality insecticides. The causes of these uneven results must be sought in the man/anopheles relationship.

Great progress has been made in the study of the biology of malaria vectors, but the African continent is so vast that what is valid for one area is not necessarily so for another. It is not sufficient to study the great climatic or geographic regions: we must have knowledge of the whole mosaic of microclimates and of the behaviour of the anopheles in each of them, if we are to establish a plan of operations which will not be found inadequate in application.

We cannot expect the same response to the insecticides from an anthropophilic vector which is exclusively endophilic as from an anthropophilic vector which is exophilic, especially if it is also exophagic. It is certain that in the regions where the vectors may attack man in the open or avoid alighting on the treated surfaces, it will be necessary to have recourse to other means in addition to house spraying if transmission is to be interrupted before resistance to insecticides develops.

In some regions larval control has been added to house spraying, or imagocide control by external means such as "fogging" by aeroplane or helicopter, but here again although the malariometric indices have fallen to a very low level, there has been no definite interruption of transmission in rural areas. The operations have to be frequently repeated as the anopheles reappear very quickly, and it is to be

feared that this repeated spraying of insecticides on the breeding places or on the external resting places of the anopheles may favour the development of resistance.

In fact, after spectacular kills, the surviving anopheles or the new generations are in contact with minimum doses of insecticide which, exposed to the sun and damp, rapidly lose their power.

In addition, these methods are extremely costly and although in some cases - in the towns or areas immediately surrounding them, for example - their use may be justified, the cost of large-scale operations in rural areas would be out of all proportion to the benefits derived.

There is, however, another way of stopping transmission, i.e. utilization of synthetic antimalarials, and there is every justification for believing that where transmission cannot be interrupted by house spraying alone, this result may be obtained by complementary chemotherapy.

Once again it will be necessary to study the areas in order to decide where such chemotherapy is necessary, and to determine the frequency and timing of the distribution of the drugs. A decision has also to be made with regard to the choice of the drug. With this method there will be no risk of hastening the appearance of resistance on the part of the anopheles, although there might be a possibility of a resistance of the parasite to certain drugs. The range of synthetic antimalarials is, however, sufficiently wide to avoid this possibility.

It will be seen from the foregoing that there are many difficulties and many unknown factors in connexion with the eradication of malaria in the African continent. The time is not yet ripe for continent-wide action, but we must not lose sight of the fact that with each day the time for such action draws nearer.

When sufficient funds are available, when the problems peculiar to each region have been studied, we may then hope - starting from already established eradication zones - to extend the activities progressively over the whole continent. But

sufficient money and the solution of the various problems by research workers will not suffice: in addition there must be steadfast determination, based on unwavering faith in the results, so as to create the team spirit and enthusiasm which will be necessary to overcome all the difficulties.