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VECTOR CONTROL AT COMMUNITY LEVEL

by

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1. INTRODUCTION

The promotion of health defined by the Declaration of Alma-Ata, 1978, implies that by the year 2000 health care should be available to everyone including: "Education concerning prevailing health problems and the methods of preventing and controlling them; promotion of food supply and proper nutrition; an adequate supply of safe water and basic sanitation; maternal and child health care, including family planning; immunization against the major infectious diseases; prevention and control of locally endemic diseases; appropriate treatment of common diseases and injuries; and provision of essential drugs" (WHO, 1979).

This broad programme would be difficult to realize without the decentralization of health projects and community participation. Vector control which is an integral part of the prevention of endemic diseases has hitherto been organized at higher national or regional levels and based on well-defined techniques that were often cumbersome and costly. The rural or urban communities that derived benefits from these measures were for the most part spectators who were more or less well-informed about what was taking place. The individual or collective health projects in which they took part were often imposed on them by coercive measures.

Things are now radically changing with the transfer of vector control activities to the village level; the spectators are becoming the actors; they will, therefore, have to be thoroughly informed as to the aims of the actions planned and the results expected so that they can decide on their voluntary participation. Health authorities will have to suggest methods that have been found effective under the local epidemiological conditions, that are compatible with the local cultural context, and that do not place excessive socioeconomic burdens on communities which often find it difficult to survive from day to day. A new type of relationship should be established between communities and health "technicians": the latter would become advisers rather than leaders.

2. AIMS AND CONDITIONS OF VILLAGE-SCALE VECTOR CONTROL

Vector control is essentially a preventive measure which in itself, or in conjunction with drug administration, should make it possible to reduce endemic diseases and to prevent or control epidemics. However, to the extent that health is not merely the absence of disease but the pursuit of individual wellbeing, vector control should also result in a reduction in the number of pests. This positive effect which can be directly felt by the people is one of the incentives encouraging them to take part.

The start of such operations must be preceded by:

- an entomological and epidemiological evaluation of the proposed methods in the context in which they will be used;

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- a socio-economic feasibility study;

- planning of structures, personnel and finance;

- a study of the prospects for continuity of operations.

2.1 ENTOMOLOGICAL AND EPIDEMIOLOGICAL EVALUATION OF THE PROPOSED METHODS

The control methods recommended must be simple, effective, inexpensive and adapted to local ecological and social conditions. Some of them, such as house spraying or individual protection, are of universal application. But the majority of the others yield very different results depending on the situation. Some examples are:

- In the Far East deforestation around villages is an effective means for the control of An. balabacensis. This practice applied in the forest areas of Central Africa would increase the number of An. gambiae breeding places.

- Larval control which is an effective means of malaria control in the arid regions of the Middle East is of very limited interest in areas of Africa where the disease is highly endemic. In these areas Anopheles vector populations cannot be reduced below the critical transmission threshold. (Carnevale et al., 1981; Molineaux & Gramiccia, 1980).

- In China, rice fields are considered the main sources of malaria vectors where larval control has to be carried out. In hyperendemic areas of Africa, although the development of rice fields increases the number of Anopheles in the nearby villages, there is no evidence that this results in an intensification of malaria. So larval control in rice fields in Africa is often questionable.

With the exception of treatments carried out inside houses, most control techniques are not used alone but in combination, i.e., integrated control. This type of intervention should stem from a highly pragmatic attitude involving the use of two or more of the available methods, chemical and biological, for the control of a vector or a group of vectors. Such techniques range from the filling in of footprints to deprive Anopheles of breeding places to using eucalyptus fumigation to repel mosquitos. However, very few workers have attempted to select the techniques applicable in a given situation, and none have tried to assess the results obtained. The measures proposed, especially with regard to larval control, might be extremely burdensome for the community and inconvenient for a population fully occupied in agricultural work.

Each technique should be evaluated for both entomological and epidemiological achievements. A compound may be an excellent larvicide and still have no effect on disease control if larval control is not the appropriate method in the local context. In this respect it is surprising that there has been no epidemiological evaluation of the larvivorous fish which have been in use for 60 years.

When several control techniques are to be used simultaneously, they all should be evaluated from both entomological and epidemiological points of view under the conditions in which the operations will be carried out.

The volume of operational research prior to the launching of any operation may seem considerable, but it is essential so that only the best and most effective methods would be suggested to the communities. It is the basis for respect between the partners and for the establishment of mutual confidence.

2.2 SOCIOECONOMIC FEASIBILITY STUDY

Every ethnic group has its own culture within which the understanding of disease/diseases and approaches to their treatment are more or less original. Although Western medical concepts have penetrated to some extent depending on the society, the mass of the people in rural areas

very often remain attached to their traditions. Their participation in vector control measures involves giving them a clear explanation of the cycle of the pathogen (of which they are often unaware) and of the actions which they are asked to undertake with the expected results.

Although a reduction in the nuisance of insect bites is not the main aim in most instances, it is nevertheless one of the effects immediately recognized by the people. It is to some extent through such successes that the continuity of operations will be maintained. There are known instances, for example of malaria control campaigns being rejected by the inhabitants because of the proliferation of DDT-resistant bedbugs. To avoid such incidents the various aspects of all the vector problems arising at the village level must be clearly determined in order to explain them to the people, taking into account the local cultural context.

There are some techniques that may be incompatible with local customs; for example, tsetse fly control in the "sacred woods" in West Africa. What must be done then is to proceed in a different way or find a compromise solution with local representatives.

The villagers are greatly involved in cultivating their plot of land and in solving the material problems of everyday life in an often impoverished environment. The part which they are asked to play in vector control must not be too onerous and must be compatible with carrying out the work on which their survival depends; in agricultural development projects it must not hold back economic expansion. Any participation beyond the capacity of the people would rapidly be abandoned.

Lastly, the occupation of the land (Hervouet & Prost, 1979) and the location of villages (Subra et al., 1975) relative to contamination sites are problems that must be taken into consideration, but whose importance often becomes apparent only after extensive geographical research. For example, it is known that onchocerciasis is not so severe when the population density is more than 50 inhabitants/km^2; consequently there is an optimum level of population which constitutes a prophylactic measure.

Serious consideration must be given to socio-economic constraints when drawing up operational plans for vector control. They must be included in health education if the message is to get across. This health education should be an integral part of school curricula, which will involve retraining school teachers; it could be implemented by the involvement of schoolchildren in community health projects. Collaboration between medical research workers and those dealing with the social and economic sciences and even agronomy is essential.

2.3 PROBLEMS CONCERNED WITH STRUCTURE, PERSONNEL AND FINANCE

2.3.1 The structural set-up for village scale vector control varies depending upon the political organization of the state or country.

2.3.2 The primary health worker or the person in charge of vector control should have at least two roles in vector control:

- the organization of health education;
- advising the members of the community who will carry out the control operations, unless he does it himself.

To carry out these tasks successfully he will have to have received entomological and/or epidemiological training, or to have been involved in these problems which he will have to solve locally. The members of the community involved in carrying out operations should receive sufficient training to enable them to accomplish successfully the tasks with which they are entrusted.

Some activities taken over from national programmes such as insecticide treatment inside dwellings may require a specialized worker full-time or part-time depending on the size of the village. It is rather unlikely that the primary health worker, who has many tasks, could

provide this service himself, or that an unpaid member of the community could devote sufficient time to it.

Given the limited skills and time of the primary health worker, vector control at the village level must have a solid backing from specialists whose responsibilities would be to work out the operational plans, to supervise their execution, and possibly to suggest new solutions. They should function less as a control body and more as a dynamic promoter of new techniques adapted to local conditions. These specialists would include fully qualified entomologists with a good knowledge of epidemiology and also epidemiologists. Far from representing a saving of scientific personnel, the transfer of vector control to the village level will necessitate increased expertise if it really wishes to accomplish its aims.

2.3.3 No discussion of the overall financial aspects of the transfer of vector control to the village level is contemplated here; in any case, these vary appreciably from situation to situation. It is sufficient to say that a programme will not be viable unless its financial implications are compatible with the resources of the country or community. Although it is hoped that the financial implications will be reduced, they will nevertheless remain considerable i.e., purchase of drugs, pesticides, spraying equipment, materials such as traps, and health education material; maintenance of sprayers and other equipment, and possibly vehicles; the salaries of permanent or temporary personnel to the extent that all needs cannot be met by voluntary labour.

2.4 THE CONTINUITY OF OPERATIONS

The lack of certainty of continuity is a criticism often levelled at major national campaigns, especially those receiving outside resources. The same question may legitimately be raised for decentralized operations at the peripheral level. For how long will the villagers retain their enthusiasm and agree to work unpaid on these activities, one of the features of which must be their perpetuity.

It is obvious that the motivation derives from perception of the beneficial effects on health and well-being, but this must be maintained by active and lively health education. While acceptable temporarily during an epidemic, requests that are too constraining will not be carried out for very long. Thus, it seems reasonable to restrict the participation of communities to measures of undoubted efficacy. It is equally essential for there to be competent personnel in the village and regular financing.

Lastly, the measures envisaged must be technically feasible in the long term. Much stress has been laid on the use of indigenous plants having insecticidal, molluscicidal or repellent properties. Before their use is recommended, it must be verified that they are plentiful enough for the source of supply not to be rapidly exhausted.

3. PROPOSED ACTION

A number of techniques or combinations of measures for which responsibility can be transferred to the village or which can be considered for decentralized vector control projects have emerged from an examination of suggestions received by WHO from the field and from the consultation of WHO experts. Entomological and epidemiological evaluation under operational conditions is already possible for some of these, but there is a need for additional preliminary information and research on the intrinsic effectiveness of others.

These measures and actions may be grouped under four headings:

1. support for existing measures in national programmes;

2. transfer to the peripheral level of techniques already employed in national or regional campaigns;

3. measures to be initiated which are specific to village communities;

4. measures to integrate vector control with agricultural activities.

3.1 SUPPORT FOR EXISTING NATIONAL CAMPAIGNS

- preparation of the population through health education for the intervention of vector control teams;

- support for geographical surveys, especially the pinpointing of isolated dwellings and bush farming huts;

- in the onchocerciasis control project in Guinea, Guinea-Bissau, Mali, Senegal and Sierra Leone, it is envisaged that entomological evaluation be under the responsibility of teams operating at the village level which have received good technical training and are well directed.

3.2 TRANSFER OF TESTED TECHNIQUES TO THE VILLAGE

Drug distribution is obviously not a part of vector control, but it is a component part of the control of diseases transmitted by vectors and thus an element in the planning of general prophylaxis. The treatment of fever cases by primary health workers or voluntary collaborators is one of the most realistic measures that can be envisaged for malaria control in countries with a low national income in which the disease is hyperendemic. Its evaluation in terms of mortality or morbidity, which is highly desirable in West Africa, involves the collaboration of demographers, sociologists, physicians and epidemiologists. The population sample must be large - about 100 000.

Transfer of house spraying and larval control measures carried out by national teams. Evaluation is concerned with the proper carrying-out of the work and the cost.

The independent commission whose task it is to define the long-term evolution of onchocerciasis control in the Volta Basin has proposed the transfer of black fly larvicidal treatment, currently carried out by helicopter, to a village team operating on the ground. This team would be headed by trained national specialists so that the results could be evaluated.

3.3 MEASURES SPECIFIC TO VILLAGES

3.3.1 Measures for operational assessment

- Although mosquito nets are a simple and effective individual means of protection, they are often badly used and poorly looked after which makes them ineffective. Information on the manufacture, maintenance and installation of mosquito nets is a task of health education. Their impregnation with an insecticide, preferably a fast acting one, would make them more effective, even if poorly maintained. Research along these lines is currently in progress including: the variety of textiles employed, use of both natural and synthetic fibres, and the impregnation technique which must be used for each.

- Water filters, even improvised ones, would enable dracunculiasis to be avoided where drinking water is not available. This is essentially a health education problem.

- The improvement of dwellings by eliminating the hiding places of reduviid bugs is regarded as a promising method for the control of Chagas' disease. An epidemiological evaluation would be highly desirable.

- Traps impregnated with insecticides have proved to be very efficient tools for controlling riverine tsetse flies in the savannah zones of West Africa (Laveissière &

Couret, 1981) and the Congo (Lancien et al, 1981). The method could be transferred to the village level. There is a need for research on inexpensive traps effective against other tsetse species in other ecological situations, especially forest areas.

- Deforestation and the clearing of undergrowth for the control of various exophilic Anopheles: An. balabacensis and possibly An. nunez-tovari, including epidemiological evaluation could be tried.

- There could be larval control or treatment of the vegetation around villages for control of exophilic Anopheles species again with epidemiological evaluation.

- Highly productive breeding places of Culex quinquefasciatus such as suburban drains or stream estuaries could be eliminated. Since severe filariasis symptoms arise from the cumulative effect of repeated infections, any reduction in the number of bites postpones or may even avoid the appearance of clinical complications. This is true both of lymphatic filariasis and of onchocerciasis.

- Aedes aegypti could be controlled by the elimination of household breeding places or their neutralization (cleaning of containers) as well as by their treatment with insecticides (temephos) made available to the villagers. Entomological evaluation is relatively easy, but epidemiological evaluation is complicated because the threshold number of bites for the development of dengue epidemics is not known. It most probably varies depending on the immune status of the population. Larval or imaginal indices that are epidemiologically significant in different situations should be determined.

- Epidemiological evaluation of the use of larvivorous or herbivorous fish should be speeded up. There has recently been a WHO consultation devoted to fish as biological control agents.

- Evaluation of various integrated measures for the control of larvae of malaria vectors could be carried out separately or in conjunction with the treatment of dwellings and chemotherapy. This is a difficult but necessary task involving the determination in several selected sites of:

(a) the reduction in the biting rate resulting from carrying out various measures carefully chosen for their acceptability to the people;

(b) the result of such a vector reduction on the malariometric indices. It is more difficult to assess in terms of morbidity and mortality (in fact the real incidence of the disease) the results achieved by vector control in highly endemic areas where people develop a strong immunity.

3.3.2 Measures for consideration

The collection of all available information on natural products, especially plants (Jacobsen & Crossby, 1971), known for insecticidal, molluscicidal or repellent action. The carrying out of limited trials on their activity, and on their toxicity for man, mammals and non-target organisms. Estimation of the availability of the product or of the local production potential. The availability of repellents that are cheap and easy to apply and capable of reducing the number of blackfly bites would be very interesting in regions where there is severe onchocerciasis.

It has been suggested that house-spraying of insecticides should be replaced by covering the walls with material (paper or fabric) impregnated with insecticide. These materials, which could be patterned or carry educative messages, would be placed in the houses by the occupants. Problems relating to the manufacture of articles having a good residual effect that could be reimpregnated, and that would be within the means of the countries concerned have still to be examined.

VBC has reviewed the available information on biological control agents and has lent its support to research on the most promising ones. This action should be continued.

The use of Cyclops sp. for Aedes control is being evaluated in Tahiti.

Field trials on the effectiveness of mucilaginous seeds should enable the future of this method to be decided.

Information on the scope for the production of Bacillus thuringiensis.

Information on the performance of traps for Culex, Aedes and sandflies.

Information on simple methods for the control of bedbugs.

Information on rat-proof containers (although probably more useful in storing foodstuffs than for public health).

3.4 INTEGRATION OF VECTOR CONTROL WITH AGRICULTURAL ACTIVITIES

Agricultural development schemes, which are very often based on irrigation, modify local epidemiological conditions as regards malaria, schistosomiasis, filariasis, etc. National specialists on vector control must draw the attention of representatives of village communities to the risks that the introduction of new cultivation methods may entail. Together they must examine the best and simplest ways of limiting or eliminating these risks. For example, the periodic drying out of rice fields or rotation of the spillways of small dams may be effective measures. However, the problem will have to be examined in relation to each particular case, especially for dams, which should be the subject of very precise epidemiological studies. There is a need to decide in which areas vector control operations must be carried out and conversely, where such operations would not yield significant results.

The introduction of certain crops may favourably change the environment. For example, eucalyptus plantations dry out marshy land by lowering the water table. The growing of the lotus in stretches of water eliminates the plants that support the larvae of Mansonia, the vector of Brugia malayi.

Lastly, renewed interest in zooprophylaxis is to be noted, although the details remain unclear. It seems practically certain that several species of zoophilic Anopheles in South-East Asia have become anthropophilic as a result of depletion of the number of cattle and that this has led to a considerable increase in malaria in some regions previously little affected. Whether or not increase in cattle breeding would reverse the situation should be considered.

4. CONCLUSIONS

It is not the intention that the suggestions set out here should be restrictive. This paper is more in the way of an appeal to the creativity and, at the same time, the common sense of researchers, inviting them to define the vector control measures that can implement the resolutions adopted for "Health for All by the Year 2000".

Each of these measures requires the concerted efforts of a multidisciplinary team to select methods of proven efficacy that are acceptable and can be accepted at the socioeconomic level, and for which continuity can reasonably be envisaged. The same group of specialists will have to provide constant technical and scientific support to those responsible in the villages, and also an assessment of the operations. They must also search for new innovative measures suitable for particular local conditions.

It will probably be only during the next decade that the scope, but also the limits and constraints of village-scale vector control will become apparent. Experience will enable existing strategies to be improved and new ones to be defined.

REFERENCES

Carnevale, P., Molinier, M. & Mouchet, J. (1981) Rev. Epidemiol. Santé publ. (In press)

Hervouet, J.P. & Prost, A. (1979) In: Maîtrise de l'espace agraire et développement en Afrique tropical. Colloque Ouagadougou 1978. Mém. ORSTOM, No. 89: 179-190

Jacobson & Crossby. (1971) Naturally Occurring Insecticide. Dekkerel, 580 pp.

Lancien, J., Eouzan, J.-P., Frezil, J.-L. & Mouchet, J. (1981) Elimination des glossines par piègeage dans deux foyers de trypanosomiase en République Populaire du Congo. Cah. ORSTOM, sér. Ent. méd. Parasitol., 19: 239-247

Laveissière, C. & Couret, D. (1981) Lutte contre les glossines riveraines à l'aide de pièges biconiques imprégnés d'insecticide, en zone de savanne humide. V. Note de synthèse. Cah. ORSTOM, sér. Ent. méd. Parasitol., 19: 49-54

Molineaux, L. & Gramiccia, G. (1980) The Garki Project, WHO, Geneva, 302 pp.

Subra, R., Mouchet, J. & Brengues, J. (1975) Environment africain, 1: 78-80

World Health Organization (1979) Formulating Strategies for Health for All by the Year 2000, Geneva, 59 pp.

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