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SEMINAR ON THE ROLE OF HEALTH SERVICES AND TRAINING INSTITUTES IN THE CONTROL OF VECTORS AND RESERVOIRS OF DISEASES

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ROLE OF HEALTH SERVICES IN VECTOR CONTROL

Dr C.P Pant
Chief ECV/VBC Division
WHO Central Office, Geneva

1. INTRODUCTION

Vector control has often been seen as the service provided to the community by higher national or regional organizations as an integral part of the prevention and control of endemic diseases. The declaration at Alma-Ata in 1978 signifies that by the year 2000 everyone should have access to health care including "education concerning health problems and their prevention and control, food supply and proper nutrition, adequate supply of safe water and basic sanitation, health care of the mother and child, immunization etc. ...." (WHO, 1979). Within this context it would seem difficult to attain these goals without decentralization of health services and the active involvement of the community both in the rural and urban centres. Thus it is foreseen that the future health services will place an increasingly greater role on the community to fulfil. As Jean Mouchet (1982) aptly described, the community who were mostly "spectators" hitherto regarding the disease and vector control programmes, will increasingly assume the role of "actors".

However, health services will have an important role in the planning, guidance, assistance and supervision of the activities carried out at the community level. During the major outbreaks of vector-borne diseases or epidemics the primary initiative for vector control operations will be the major responsibility of the regional or national health services. In planning of any control measure as discussed under the agenda item 6, it is imperative that basic data and information is available on all aspects of the disease, its reservoir(s) and vectors. There is always the difficulty of having sufficient resources to carry out all the desirable activities to obtain such information. Very often it may be necessary to cut down on the exhaustive surveys required and plan to carry out essential activities. In this respect a brief summary of some of the examples of activities is given below:

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

Mouchet, J. (1982) Vector Control at Community Level. WHO/VBC/82.847.

2. EPIDEMIOLOGY OF VECTOR-BORNE DISEASES IN THE COUNTRY

This subject will be discussed giving a few examples for some of the diseases and essentially similar activities may have to be carried out for others.

2 1 Malaria

Various types of information required have been documented exhaustively and the basic information required is given below:

- Species of parasites and their relative frequencies. Areas and population covered by transmission with detailed maps and tables.

- Seasonality of transmission and the prevalence of parasitaemia, target population etc.

- Incidence of new infections (e.g. annual parasite index, API), by area and species, giving the precise method of detection, target population and the numbers actually examined (e.g. annual blood examination rate), maps showing these results by districts or regions

- Susceptibility of the parasites to the anti-malarial drugs.

- Species of anophelines present in the country with maps showing their distribution

- Vectorial status, breeding habitats, seasonality of the vector prevalence and breeding, extensiveness of the breeding sites, human activities in relation to breeding

- Biting behaviour, endo-exophagy, zoophily-anthropophily, feeding cycle and biting cycle

- Vector densities by season/infection rates if applicable.

- Resting behaviour - endo-exophily

- Susceptibility to insecticides

- Susceptibility to infection by parasites.

- Human variables, morbidity, mortality, migration, housing types, way of life, habits, knowledge and attitudes, genetic traits

In addition to these essentially epidemiological factors, very often the human factor and the socio-economic factors assume a great deal of importance in planning effective malaria control activities. Each ethnic group has its own culture and tradition especially in the rural areas. Their conception of disease and appreciation of vector control measures is very often limited and they remain attached to their traditions. Furthermore, their economic prosperity and well-being depends on agricultural activities which naturally take priority over everything and they should not be asked to play roles which may not be compatible with agricultural activities on which their survival depends. Should their participation be planned beyond these factors, it is certain that sooner or later it will be abandoned. Within this context it may be important to mention that any such activities will only be successful if continuity is ensured. Planning should not be carried out in such a way that continued efforts may not be feasible thus resulting in more harm than good.

3. ARBOVIRAL DISEASES

The arboviral diseases with particular reference to Rift Valley Fever present mainly epidemic or epizootic problems in areas where large numbers of cattle and sheep occur. When ecological conditions suitable for breeding of large numbers of culicines exist, especially under unusual weather conditions, e.g. exceptional rainfall or high temperatures, flare-up of the disease may occur.

WHO (1982) recommended the following surveillance mechanisms including case-finding, isolation of virus, demonstration of the antigen in vectors/vertebrates, antibodies of RVF virus in man or domestic or wild animals.

- Surveillance of clinical disease in animals particularly widespread abortions and deaths in young animals. Clinical disease in man. Case finding may depend largely on the education of farmers, veterinarians, physicians and the general public using a combination of features, namely fevers, blindness, encephalitis, deaths from haemorrhagic disease, abortion in domestic animals, etc.

- On the laboratory, isolation of the virus from human blood and autopsy specimens and the detection of antigens to RVF using any modern immunological technique. Serological tests to detect RVF antibodies in man or domestic animals should also be applicable.

WHO (1982) Rift Valley Fever: An emerging human and animal problem. WHO, Geneva, 1982

- Entomological surveillance is especially important since ~~this~~ may be used as a warning mechanism as the RVF epidemics or epizootics would seem most likely in areas with large numbers of cattle and sheep and ecological conditions suitable for the breeding of exceptionally large populations of culicines under unusual weather conditions. The following minimal entomological surveillance measures are recommended:

  - Identification of local mosquitos (where necessary this may mean preparation of taxonomic keys), tentative incrimination of vector species based on population densities and mosquito bloodmeal analyses showing preference for sheep and cattle.

  - Seasonal assessment of mosquito densities both indoors and outdoors of the potential mosquito vectors using established entomological techniques.

  - Breeding habitats of mosquitos (potential vectors) and longitudinal meteorological observations.

  - Viral infection rates of pooled mosquitos.

  - Susceptibility of mosquitos to insecticides

These guidelines will in general be applicable to other arboviral infections also.

Table 1. Some examples of arboviral infections, with special reference to the Ethiopian region, and their vectors.

Viral Disease	Vaccine for Mass Treatment	Primary Vector(s)
Chikungunya	No	<u>Ae. aegypti</u> <u>Ae. africanus</u>
O'Nyong Nyong	No	<u>An. gambiae</u> s.l. <u>An. funestus</u>
Dengue	-	<u>Ae. aegypti</u>
West Nile	No	<u>Cx. univittatus</u> <u>Cx. pipiens</u>
Wessel bron	No	<u>Ae. caballus</u> <u>Ae. circumluteolus</u>
Bunyamwera	No	<u>Ae. circumluteolus</u>
Bwanba	No	<u>Aedes</u> sp.?
Rift Valley Fever	Yes	<u>Cx. pipiens</u> s.l. <u>Cx. theileri</u> <u>Ae. caballus</u>
Yellow Fever	Yes	<u>Ae. aegypti</u> <u>Ae. africanus</u> <u>Ae. simpsoni</u>

4. RICKETTSIAL DISEASES

Louse-borne typhus fever may occur in colder areas under conditions of primitive hygiene, the infectious agent being Rickettsia prowazekii and the vector, the body louse, can be a significant disaster problem under the conditions of war and famine.

Flea-borne typhus caused by Rickettsia typhi (R. mooseri) is also of worldwide occurrence when man and rodents occupy the same buildings. Rodents, commonly Rattus rattus or R. norvegicus, are the natural reservoirs, and rat flea, Xenopsylla cheopis, is the common vector.

Effective residual insecticides applied at regular intervals to clothes and personal effects and improvement of living conditions, immunizations of susceptible individuals (a live vaccine has shown some promise) against louse-borne typhus fever has been recommended.

For flea-borne typhus, application of insecticide powders with residual action to rat runs, burrows and other habitats is recommended. Rodent control methods should be preceded by flea control.

Scrub typhus may be of importance to a very limited area of the region as the western boundary of the distribution has been recorded as central Pakistan. The disease is caused by Rickettsia tsutsugamusti and transmission occurs by the infective bites of trombiculcid mites, Leptobothridium akamusti and L. deliensis. Prevention of contacts with infective mites and prophylaxis against the mite vector using repellents are the common measures used for prevention of the disease. Insecticides have been applied to eliminate mites from specific areas.

5. SNAIL INTERMEDIATE HOSTS

Control of snail intermediate hosts of Schistosoma spp., of which man is the principal reservoir, can be largely obtained by improved irrigation and agricultural practices, drainage, filling and treatment of snail breeding places with molluscicides of which only one, niclosamide, is presently available. It is understood that molluscicıding should be done in conjunction with other environmental measures. The basic information required for planning any control measure is as follows:

- Prevalence, incidence and intensity of infection.
- Quantitative investigations on snail populations
- Human ecology and behaviour patterns including human/water contact, sanitary habits.
- Acquired immunity particularly when chemo-therapeutic methods are being used including reinfection rates, morbidity rates and experiences, patterns of infection in the immigrants and indigenous population.

- Clinical manifestations.

- Snail biology and intermediate host-parasite relationship.

- Identification and quantitative aspects of the snail population.

- Location and time-patterns of transmission foci within any particular area especially for man-made water resource developments.

- Life cycle and infection and seasonal patterns of the production of cercariâe and transmission of infection.

- Ecology, bionomics and population dynamics of the molluscan host.

Probably no single method of control will be totally satisfactory. In some areas chemotherapy may be considered but in others chemical control of molluscs, particularly based on a rational application of chemicals applied, use of cheaper chemicals, focal use of the molluscicides rather than widespread coverage, use of molluscicides of plant origin (Kloos and McCullough, 1981), would be advisable.

McCullough et al (1980) have reviewed the subject of molluscicides in schistosomiasis control. As mentioned earlier, only one molluscicide is presently being produced commercially.

Among the controlled release formulations only tributylin oxide (TBTO) has given satisfactory long-term results. The molluscicide of plant origin which has been extensively tested is Endod derived from the berries of the climbing plant Phytolacca dodecandra.

Marisa cornuarietis, a well-known ampullarid competitor/predator of Biomphalaria sp. in Puerto Rico, has been tried for the first time in Africa and successfully established in a locality in Tanzania where it has resulted in a successful elimination of Biomphalaria pfeifferi, Lymnaea natalensis and Bulinus tropicus (Nguma, McCullough and Masha, 1982).

Kloos, Helmut and McCullough, F. (1981) Plant molluscicides: A Review. WHO/VBC/81.834.

McCullough, F.S., Grayral, P., Duncan, J and Christie, J.D. (1980) Molluscicides in schistosomiasis control. Bull. Wld. Hlth. Org., 58(5): 681-689.

Nguma, J.F.M., McCullough, F.S. and Masha, E. (1982) Elimination of Biomphalaria pfeifferi, Bulinus tropicus and Lymnaea natalensis by the ampullarid snail, Marisa cornuarietis in a man-made dam in northern Tanzania. Acta Tropica, 39, 85-90, 1982.

6. RODENTS AND RODENT-BORNE DISEASES

Commensal rats and mice (R. rattus, R. norvegicus and Mus. musculus) have a world-wide distribution and in addition to being household pests they carry disease and act as reservoirs for plague, murine typhus, Leptospirosis, lymphocytic choreomeningitis (LCM), rickettsial pox, rat-bite fever, trichinosis, etc. Rats and mice also cause a significant loss of food crops, stored food stuff, and damage to the structural parts of buildings etc

Commensal rodent control depends mainly on environmental sanitation, rodent exclusion, mechanical rodent-proofing, use of repellents, trapping, fumigation, use of rodenticides, etc. depending on the specific requirement. For details see the excellent brochure "Commensal Rodent Control" by Brooks and Rowe (1979).

The role of the Ministry of Health and the health services is clearly to identify the problem, analyze the situation and recommend the most cost-effective method suitable for the specific problem.

7 SUSCEPTIBILITY LEVELS OF THE VECTOR/RESERVOIRS TO PESTICIDES

Whenever chemicals are used for vector or reservoir control, there is always a potential or actual threat of development of physiological resistance Resistance has been recorded in all groups of important vectors/reservoirs and has caused serious operational problems to many programmes. The WHO Expert Committee on Resistance of Vectors of Disease to Pesticides (1980) stressed that whenever vector control operations involving the use of pesticides are carried out it is essential to routinely determine the susceptibility status of the vector species concerned. Base-line data on the susceptibility and subsequent detection or monitoring of resistance should be carried out.

Presently altogether 51 species of anophelines have been reported to be resistant to one or more insecticides (34 to DDT, 47 to Dieldrin and 30 to both DDT and Dieldrin, 10 to OP compounds and 4 to carbamates) Among the culicines, 42 species have been reported to be resistant to one or more insecticides. DDT resistance has now been detected in Phlebotomus papatasii in N. Bihar, India. DDT resistance in Simulium damnosum from many parts of W. Africa has been confirmed and loss of susceptibility to temephos has been reported from certain areas of Ivory Coast. The body louse has developed resistance to DDT in

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Brooks, J.E. and Rowe, F.P. (1979) Commercial Rodent Control WHO/VBC/79 726.

WHO (1980) Resistance of vectors of disease to pesticides. TRS 655.

virtually every area and malathion resistance has been reported from Egypt, Burundi and Ethiopia. Fleas Xenopsylla cheopis and X. astia have been found to be resistant to DDT in Burma and Indonesia. In the houseflies multi-resistance to DDT, dieldrin and several organophosphorus and carbamates, including pyrethroids, is widespread. Cross resistance to pyrethroids amongst the DDT resistant strains of several insects of medical importance such as Ae. aegypti reported from some countries, e.g. Thailand, poses serious problems for control. Cimex hemipterous which earlier developed resistance to DDT has been shown to be resistant to malathion in India and Sri Lanka. Resistance to several groups of insecticides has also developed in cockroaches and ticks. Resistance to anti-coagulants has developed in the Norway rat, Rattus norvegicus, R. rattus and Mus. musculus and decreased susceptibility of Bulinus truncatus snails to niclosamide has been noted in certain foci in Iran.

Early detection of vector resistance on the basis of a systematic search for proper planning and execution of control measures is of vital importance and WHO Expert Committees on vector resistance have promoted rapid tests and methodology. The use of diagnostic concentrations has been recommended to simplify the procedure and enable coverage of large areas. Monitoring objectives and strategy have been clearly defined and test methods to carry out such monitoring have also been fairly well developed.

The serious problem that is progressively developing in vector control owing to the phenomenon of resistance has prompted considerable interest in means of retarding or inhibiting the evolution of resistance. This entails efforts not only in discovering new compounds that would not be affected by cross-resistance but also devising application techniques and strategies that would forestall the development of resistance. Amongst the principal areas currently being explored are:

- Use of alternative chemicals.
- Dosage management.
- Mosaic application of chemicals.
- Use of insecticides in mixtures, rotations and optimum sequences.
- Integrated control.

Obviously some of these measures are still within the realm of research and the role of a health service and its relevant wing for research in vector biology and control is to study this problem and arrive at the most cost-effective measures which the country can afford. Thus there may be a need for a research component within the health services dealing with such problems amongst the others.

8 SAFE USE OF PESTICIDES

Increasing use of pesticides is being made for the control of vector-borne diseases and increased food production and this may raise the environmental and safety questions. A WHO Expert Committee on Safe Use of Pesticides (1979) and the earlier reports have exhaustively dealt with this question. The Committee considered that although considerable amounts of pesticides are at present being imported from the industrialized countries, it is expected that more developing countries will, in the future, prepare their own formulations and even pesticides. Good manufacturing practice and quality control will then obviously have to be ensured. The countries will have to endeavour to become self-sufficient in this respect and the first priority will be the establishment of an inter-departmental control agency for the registration of pesticides. Legislation will be required to define the powers and responsibility of the agency. All available expertise in chemistry, pharmacology, biochemistry, pathology, toxicology in the country may have to be exploited and consulted particularly for training in diagnosis, treatment and prevention of pesticide poisoning. There is also a need to establish methods for information dissemination to the farmers, extension workers, public health workers and those in charge of spraying programmes and health authorities and hospitals in the area where poisoning treatment may be carried out. Amongst the factors influencing the toxicity of pesticides are.

- Dosage rates employed.
- Toxicity of the compound.
- Formulation employed
- Route of exposure.
- Temperature.

Impurities in pesticides either during faulty manufacture or storage or both may have a profound influence on the biological activity and potentiation of toxicity (e.g. presence of isomalathion in the malathion formulations). Strict adherence to the specifications of pesticides as published by WHO from time to time could prevent such occurrences

Health services also have the responsibility of ensuring that precautionary measures to monitor exposure and safe use of pesticides are undertaken by those using these for disease prevention and control. Training of spraymen and supervisors is vital and guidelines for safety precautions have been provided in WHO (1979).

WHO (1979) Safe use of pesticides TRS 634

Health services also have the responsibility of informing all concerned on the treatment of poisoning due to common insecticides. Annexures to WHO (1967) and WHO (1973) and WHO (1979) have attempted to provide information on this.

9. INTERSECTORAL AND INTERNATIONAL COLLABORATION

It is now being increasingly realized that unless there is intersectoral collaboration any vector control/disease control plan will not succeed. The integrated control of several important vectors may require a combination of measures such as:

- Drainage system.
- Piped water supply
- Refuse disposal.
- Use of mosquito screens.
- Removal of aquatic weeds.
- Use of larvicides.
- Residual spraying indoors of premises.
- Space spraying.
- Larvivorous fish.

When one considers that the mosquitogenic potential of any area depends to a large extent on factors which may be beyond the control of the Ministry of Health, the need for inter-sectoral collaboration becomes all the more important A good example is the development of irrigation networks for crop irrigation. In an undertaking of this nature at least the following ministries may be involved:

- Planning
- Agriculture
- Finance
- Public Works and Engineering
- Health
- Socio-economic, etc.

WHO (1967) TRS 356

WHO (1973) TRS 513

Similarly, in order to take corrective action for vector control many ministries are involved. The role of municipalities in the planning of control measures for urban vectors/reservoirs of disease is well recognized. In several other cases the Ministries for Forestry, Defence, Highways, Railways, etc. may be involved. When one considers that training and dissemination of information is also an important sector of comprehensive vector control services, the role of research institutes and universities also becomes apparent Thus an important function of the health services is to ensure that inter-sectoral collaboration is maintained during the planning and operational aspects of vector/disease control.

International collaboration may be required in many aspects of vector/disease control programmes particularly the following.

- Training
- Information
- Research
- Supply of equipment
- Testing of equipment and insecticides
- Evaluation
- Specifications
- Emergency operations

10. EVALUATION AND ASSESSMENT

In all the vector control operations unless a proper evaluation and assessment is carried out one is never certain whether the resources are being utilized properly resulting in the desired effectiveness. Hence, evaluation and assessment should be an integral part of the operations. This may consist of monitoring of vector densities before and after control operations have been instituted and their longitudinal assessment. All vector control activities must be evaluated both in terms of vectors (density, longevity) and the incidence of disease Whenever possible a cost-effectiveness analysis should be made.

11 TRAINING AND CAREER DEVELOPMENT AND CADRE FOR HEALTH PERSONNEL

It has been often seen that there is a serious lack of trained vector control personnel within the cadres of the Ministries of Health and Health Services. This is often acutely felt in several developing countries particularly for entomologists and other specialists such as sanitary engineers and sanitarians. It is important that facilities for training be developed but unless there exists a proper cadre for the professionals and opportunities exist for the promotion of such staff, it is certain that they will not stay within the Ministry of Health, but move to more lucrative jobs where they may be able to earn higher salaries and where their future prospects are more secure

Training can be organized by the Universities and Institutes where a formal degree, such as an M.Sc., can be offered. Besides these ad hoc training courses, refresher training, in-service training and periodic training courses can be organized and given. The role of international collaboration can be very useful here since it may be more cost-effective to take advantage of such training facilities within the region or neighbouring countries.

Whenever training is planned the details of the course, curriculum, duration, instructors and trainers etc. have to be carefully planned keeping in mind the objectives of the course.

12. CONCLUSION

It may thus be concluded that in order to carry out its functions, as given in detail in the preceding section, the Health Service of the country in question may have to create, if it does not already exist, a suitable unit and section dealing with all aspects of vector control including research, planning, execution of operations, evaluation and assessment and training and dissemination of information. This unit should also be responsible for the required inter-sectoral and international collaboration which is essential for the success of the programme. This may entail some modification of the present system in many countries where separate structures exist within each disease control organization or set-up. It may be more cost effective to have one such unit within the Ministry of Health with responsibilities for separate disease problems so that the available expertise can be utilized to the maximum. This may also lead to having personnel with polyvalent expertise, who could be called for service whenever required. The number of staff/strength of such a unit will naturally depend on the size of the country and vector-borne diseases and problems.

The management of such a unit may depend on the existing administrative practices of each country and no hard and fast recommendation can be made since this is more or less a local problem. However, it is hoped that the functions to be fulfilled by such a unit as given in the preceding section will throw some light on the expected type of organization required for the management.