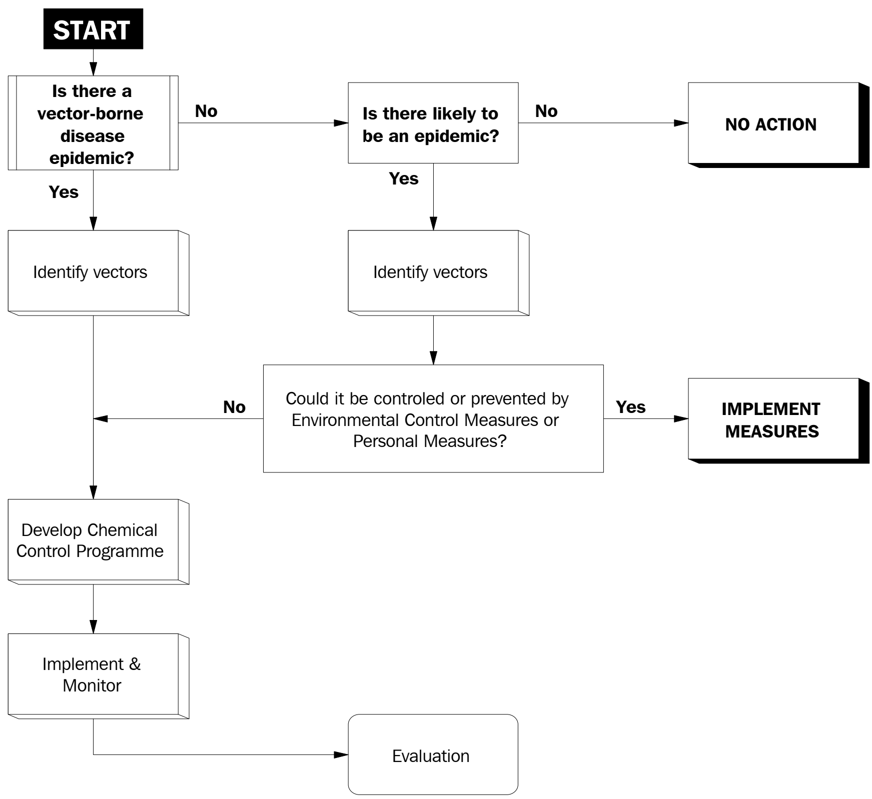
4.

Overall Process for Implementing a Vector Control Programme

4.1 Introduction



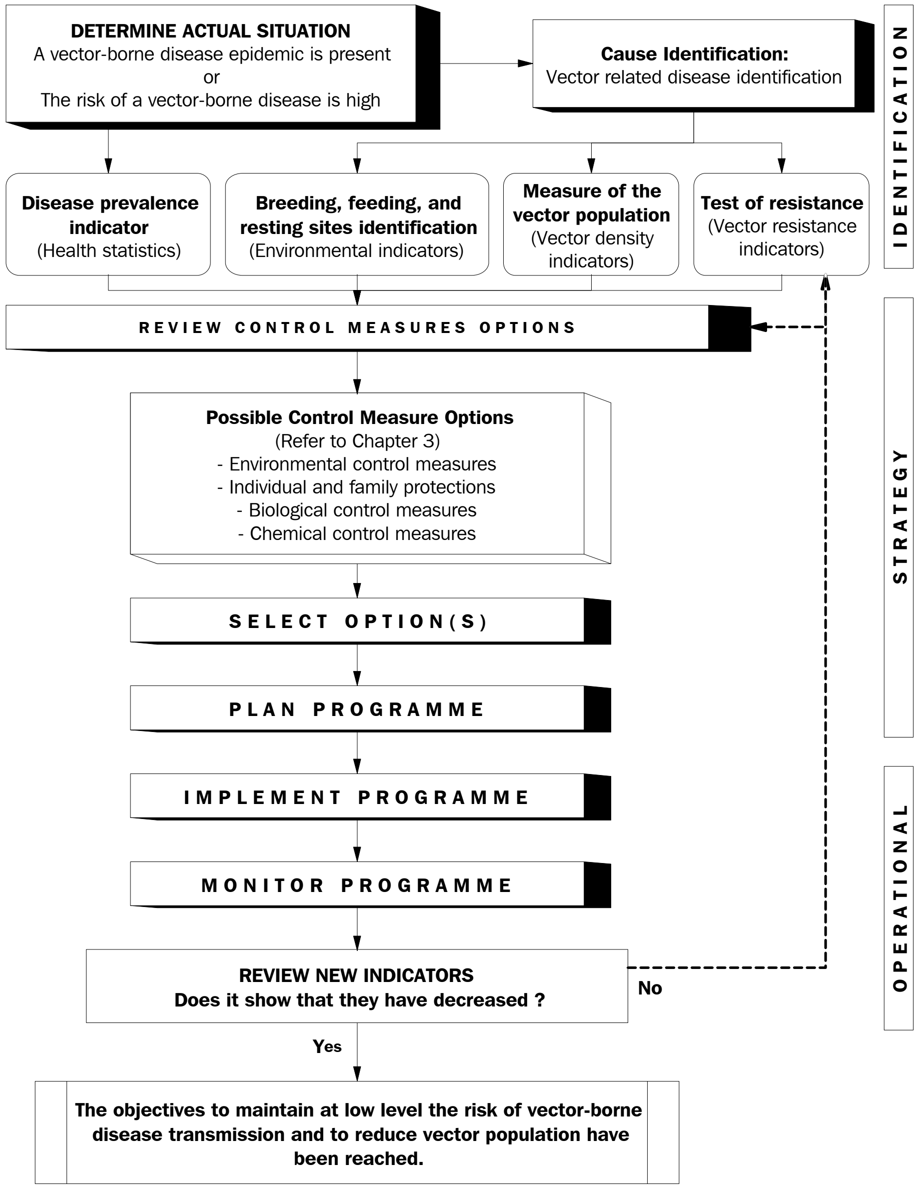
Flowchart S1. Decision to carry out a Vector Control Programme based on a specific health problem within the camp

Propagation of insects and rats is favoured by the breakdown of sanitary facilities following a natural disaster, a conflict, or by the environment created in a settlement of a refugee emergency situation. In such cases, transmission of vector-borne diseases to the affected population will increase, and may result in an epidemic. Environmental control measures combined with facilities for personal hygiene, should be appropriate for the long term control of vectors and disease transmission. However, these long term control measures are not appropriate enough for the needs of an emergency short term action where an epidemic is already happening or about to happen. To face the threat of an epidemic, the principal approach should be to obtain a rapid and maximum control of vectors. Chemical control measures may be required to supplement long term control measures and to prevent epidemic disease outbreaks. Although chemical control measures should supplement any sanitary measures, in the case of an epidemic, a chemical control measure programme is still the most appropriate and suitable strategy depending upon which vectors need to be targeted.

The decision to implement a vector control programme should not always be based only on health statistics- if the field worker waits for health statistics to indicate an epidemic situation the crisis may have reached its peak and passed by the time the epidemic response activities have been initiated. This is what normally happens. However, many epidemic diseases are highly predictable, for example, the arrival of persons without immunity to malaria into an area of high risk for malaria- e.g. former Zaire, 1996. People fleeing the fighting from the mountainous areas of Masisi, where there is no malaria, to the malarial Goma/Sake lowland. Under such circumstances it is disastrous to wait for the predictable epidemic to occur before undertaking malaria control activities. Similarly, heavy body lice infestations in camp environments risk epidemic typhus and many deaths. Vector control should not wait for the sick and dying to be recorded (Thomson, 1995).

The objective of this chapter is to provide a tool for collecting and recording indicators which should help the field engineer to have a clear understanding of the actual situation, and to reach appropriate conclusions to develop, implement and monitor chemical control measures.

4.2 Steps for implementing a vector control programme



Flowchart S2. Steps for implementation of a Vector Control Programme

4.3 Identification (Flowchart S2)

This consists of collecting indicators which should help field workers to understand and get an overall picture of the actual situation, and also to design a response to control vectors and the diseases they transmit. The two most common and simple indicators to measure are disease prevalence and vector counts (Sphere Project, 1998).

4.3.1 Health statistics indicators

In an emergency situation it can be very difficult to get proper health statistics as diagnostic facilities, such as field laboratories, may not yet be available. That is why malaria and other diseases may often be listed in the category of "fever of unknown origin". A vector control programme should be based on a good understanding of the disease, its potential contribution to morbidity and mortality, the local environment and the population involved; and of course, health statistics should be used to monitor the situation and, where problems are not highly predictable, should be used to trigger activity (Thomson, 1995).

When collecting health indicators it is better to try to get health statistics per district within the camp to identify which part of the camp population is the most affected and this should help to locate the source of the problem. Health statistics should be collected with the support of any medical officer. Morbidity rates and mortality rates are needed in order to appreciate the medical situation.

4.3.2 Vector identification (Refer to Chapter 2)

Once the vector-borne disease has been identified, it becomes easy to know the vector species involved in the transmission of that disease- e.g. Yellow fever is transmitted in urban areas by the *Aedes aegypti* and by seven other *Aedes* species in rural areas, and by *Haemugogus* species in jungle areas in Latin America. Simple reference texts can also be used to help the field worker in the task of vector identification. Additional data based on the known geographic distribution and ecology of the vector should confirm the identification. In any case, the biological identification should be done with an experienced technician, or a vector specialist such as an entomologist if available.

4.3.2.1 Breeding, feeding, and resting sites

Once the vector species has been targeted and its behaviour has been studied, it should be easy to locate their habitat, feeding, and resting sites. These must be carefully identified and removed if possible. Each located breeding site should be recorded and mapped to monitor the number of them. Breeding sites will increase with the arrival of the rainy season for some insects such as mosquitoes and certain flies.

4.3.2.2 Vector population density

The vector population density depends on the local climatic conditions and the environment made by human presence. Temperature, humidity and particularly rainfall, will significantly increase the number of certain vectors such as mosquitoes and flies. The estimation of vector population density is quite difficult for an inexperienced person to undertake, and the accuracy of this counted sample may not be reliable enough. The number of vectors to be targeted can be estimated by counting the vector population within localised samples and using some unit of measurement such as the number of vectors per surface area, per unit period of time or per individual person. For example, lice: percentage of persons found positive upon inspection. Non-biting flies: number of landings counted on a standard surface grill within a given time period. Traps and insecticides can be used for collecting specimens. Procedures for estimating vector population are given in Appendix 3.

4.3.2.3 Resistance to insecticide

Resistance can be defined as the ability of a given organism to survive after it has received a certain toxic dose of an insecticide which should normally have killed it. Before the implementation of a vector control programme, the susceptibility of the targeted vector to an insecticide has to be carried out to determine which insecticides and/or larvicides are going to be used. There is no point in considering a vector control programme if resistance tests of the insect to the insecticide have not been carried out. If vector resistance has not been tested there is a considerable chance that the programme will fail. During the on-going programme, it is also necessary to regularly monitor the susceptibility of the targeted insects to an insecticide. With this kind of monitoring system, if the insect becomes resistant the field engineer has the option to move to another insecticide or to use a different mode of application. However, different factors may be responsible for the failure of a vector control programme or may contribute to the development of a resistance. These include:

- inappropriate strategy;
- poor quality of spray application;
- change in behaviour of the targeted arthropods; and

- bad coverage of the spraying.

The World Health Organization (WHO) has developed a standardised susceptibility test kit. The principle is to place a group of the targeted insects into an exposure tube containing insecticide-impregnated paper for a period of 1 hour. The group of insects is then removed to an other tube to observe their recovery during 24 hours. If 20 % or more of the insects are still alive then resistance to the insecticide must be considered (Chavasse & Yap, 1997). The test may seem easy to implement, but the analysis of the result may be more difficult and has to be carried out within a strict and good understanding of the scientific problems that the test imposes (Thomson, 1995). Although a note book is provided within the kit, an experienced technician is required to carry out this test properly.

Implementing organisations should be aware that **it is unrealistic for an inexperienced person or a non specialist to implement any resistance test without the specific and scientific knowledge that these resistance test kits impose**. However if there is no specialist to implement such a test, The WHO has developed a World Programme of Surveillance of Insecticide Vector Resistance which should be able to provide the information on insecticide resistance at a regional scale anywhere in the world. The information provided by this should be more accurate than a beginner implementing a resistance test which may jeopardize the test itself and the project.

Resistance development may be reduced or avoided by using insecticides which have a short persistence (2/3 months). Insecticides and/or methods of application should be alternated (Sabatinelli, 1996).

4.3.2.4 Mapping the indicators collected

It is essential to display all the data collected onto a map as this will give an overview and a better understanding of the actual situation to be monitored. Every detail must be provided in the map such as communication routes, access to vector habitats, natural and man-made breeding sites, health centres, defaecation areas, latrines, uncontrolled waste disposal - any place where water is present including water collection points within the camp, rivers, swamps, water holes, leaking water supply and vegetation. Places where vector population measurements have been recorded must figure in the map and be dated. The map and details should be done according to the vector targeted at an appropriate scale which allows for easier reading and evaluation of the map.

Table 4.1. The main known examples of vector resistance

Vectors	*Geographical distribution*	*Known resistance*
Anophelines mosquitoes *A. gambiae s.l.* *A. funestus*	Africa	DDT and cyclodiene (OC)
A. arabiensis	Sudan	malathion (OP)
A. gambiae s.s.	West Africa	permethrin (PY)
	Asia	most of the vectors are resistant to DDT, but DDT is still considered useful in India because it drives malaria vectors outside.
A. stephensi	India, Iran, Pakistan	malathion (OP)
A. culicifacies	India, Sri Lanka	malathion (OP)
A. sinensis	China, Japan, Korea	some organophosphate compounds (OP)
A. albimanus *A. pseudopunctipennis*	South America and Central America	some organophosphate compounds (OP) and carbamates (C)
Aedes mosquitoes *A. aegypti*	Americas, Asia	DDT, some organophosphate (OP), some pyrethroids (PY)
A. albopictus	Madagascar	DDT, some organophosphate (OP), some pyrethroids (PY)
Culex mosquitoes *C. pipiens* *C. quinquefasciatus*	Urban areas Europe, Brazil, India	A large variety of insecticides and biological larvicides
C. tritaeniorhynchus	South East Asia, China, Japan, Korea, Sri Lanka	organophosphate (OP) organochlorine (OC)
Mansonia mosquitoes *M. annulifera* *M. indiana*	Thailand	organophosphate (OP)
Simuliid fly *Simulium damnosum*	West Africa	chlorphoxim, temephos (OP) pyrethroids (PY) carbamates (C) DDT (OC)
Phlebotomine flies *Phlebotomus papatasi* *Phlebotomus argentipes*	Africa (kenya) India Turkey	DDT
Cockroach *Blatella germanica*	Worldwide	DDT (OC) and resistance to other insecticide in USA, Europe and Japan

Source: Adapted from Guillet, 1995

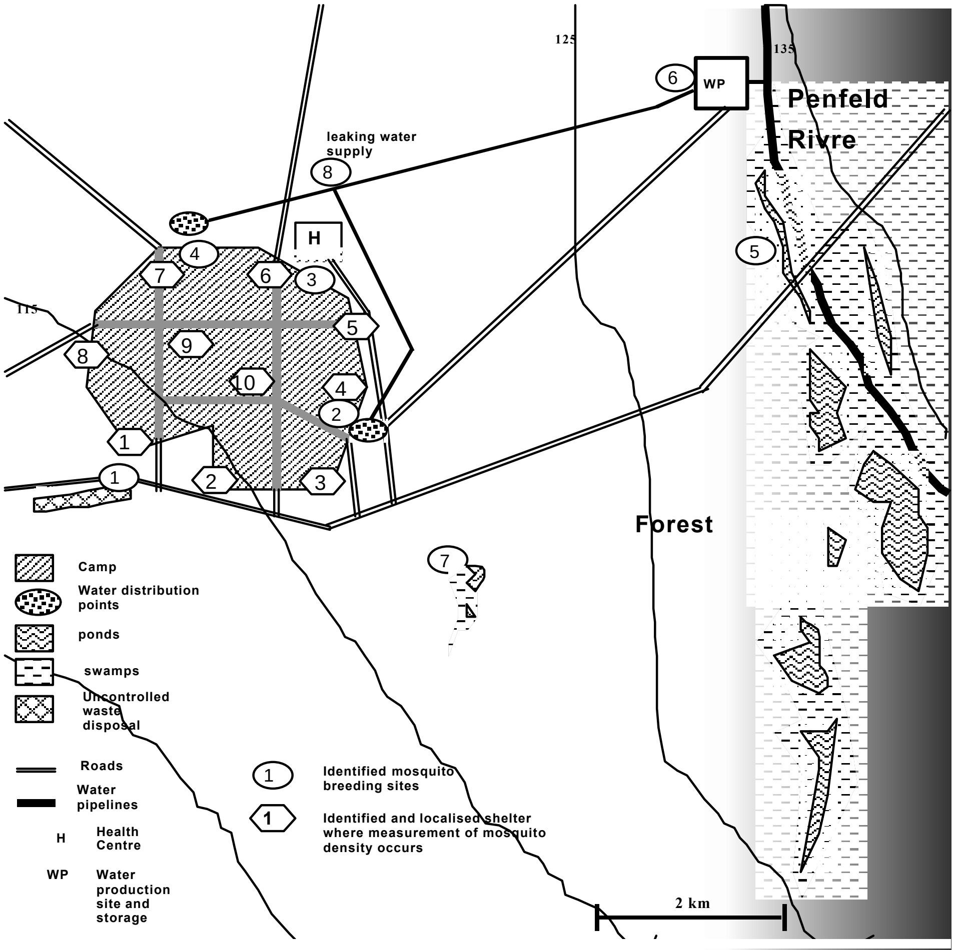


Figure 4.1. Indicators for malaria control (Lacarin, 1999)

The example of an indicator mapping in Figure 4.1 shows the indicators for malaria control. It seems that most of the breeding sites are man-made within the camp. They are easily located and may be removed rapidly. Shelters where the measurement of the vector population density will take place are carefully chosen and recorded on the map so these same shelters can be periodically measured for vector population density, in order to monitor the effectiveness of the spraying programme. Malaria health statistics indicators may be added on the map, per district if possible. This will show the districts which are most affected by the disease and should help to identify the source(s) of the problem, and where the control activities should start.

4.4 Strategy (Flowchart S2)

The decision to carry out vector control measures should be based on clinical evidence that a vector borne disease epidemic is occuring, or a high risk of one occurring in the near future. There are 7 main reasons why the affected population may be more susceptible to disease than the host community.

1. They have a low immunity
2. They have fled through or to an infested area where disease is endemic
3. Their camp is situated in an area which the local population have avoided
4. They have lost their livestock
5. They are malnourished
6. They have suffered injuries and trauma resulting in blood loss
7. They are living in crowded and insanitary conditions

The objective is to target any arthropods of medical importance to reduce and maintain them at a level at which they do not present a danger of disease epidemic transmission to the affected population.

The field worker involved in an emergency situation must bear in mind that chemical control measures should be used as a supplement to any good environmental control measures. Environmental control technology such as safe excreta disposal for controlling flies, and drainage of any standing water for controlling mosquitoes, will have some pertinent impact on these vectors of medical importance. However, these technologies may not be sufficient to reach all breeding, feeding, and resting sites within the settlement and its surroundings.

Chemical control measures and/or individual protection measures should be carried out in anticipation of, or during a vector-borne disease epidemic. The setting up of all the hygiene facilities such as safe excreta disposal, solid waste management, wastewater disposal, site drainage will take from a few weeks to months before benefiting the majority of the affected population.

When people are sick and dying because of a vector-borne disease epidemic the only way to reduce the vector population to a level at which it presents no major epidemic risk is by immediate chemical control measures.

4.4.1 Select options

Chemical control option strategies and technologies are numerous. The effectiveness of a vector control programme will be based on a clear scientific and technical understanding of the problem given and the appropriate response to deal with it. These must include the following factors:

1. A clear understanding of basic entomology and identification of the vector(s).

2. A clear understanding of chemical selection, chemical use and its dangers.

3. Knowledge of application equipment.

4. Knowledge of safety measures.

(see Chapter 5)

Flowcharts S3 and S4 provide a simple and basic synopsis which should help the decision-maker in selecting appropriate and suitable control measures according to circumstances. Although these afford a comprehensive general survey to select option(s), the final decision must include and be based on the analysis of the factors given above.

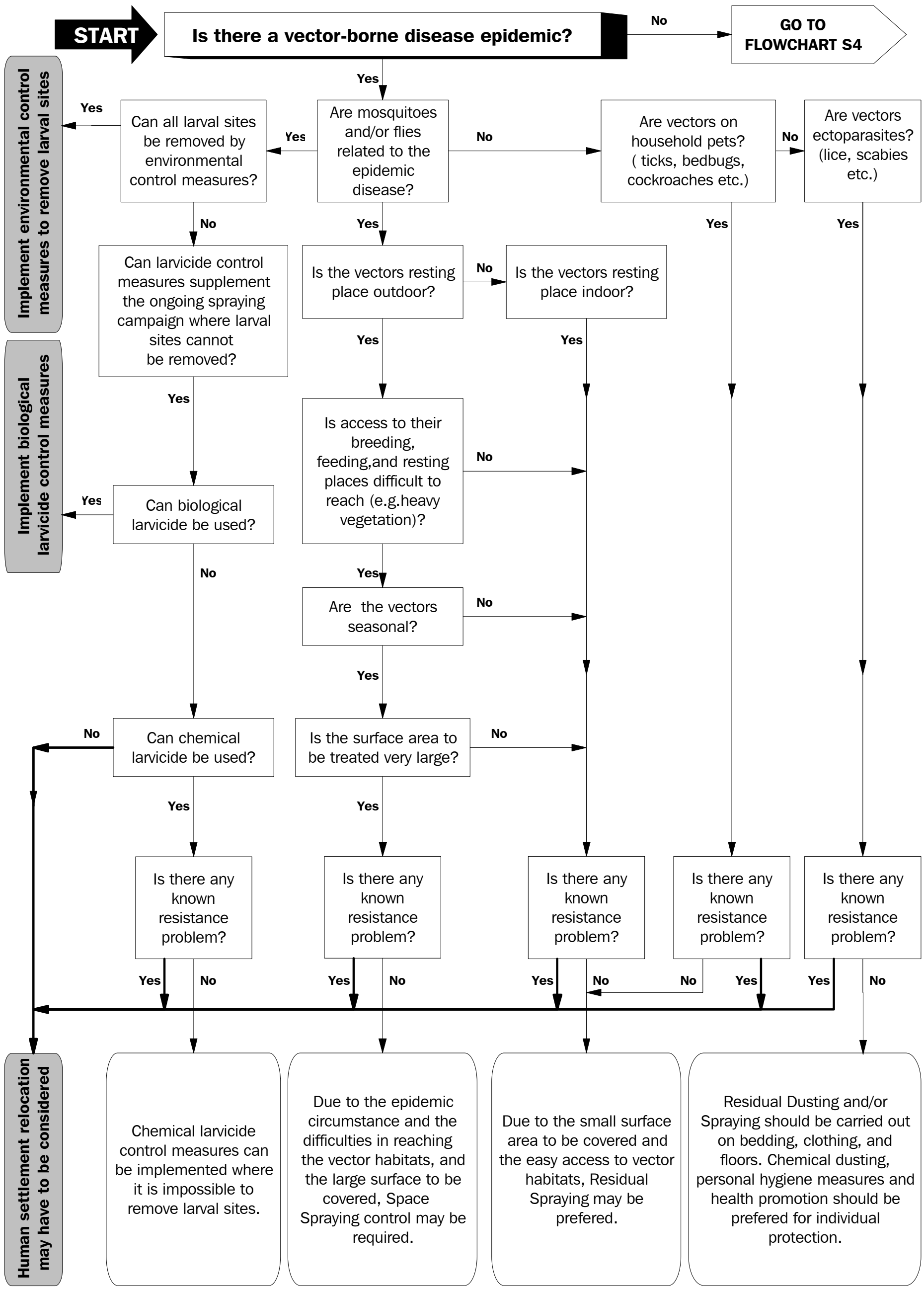
Appendices 1 and 2 provide suitable chemical control methods categorised by vectors with application procedures.

4.4.2 Plan programme

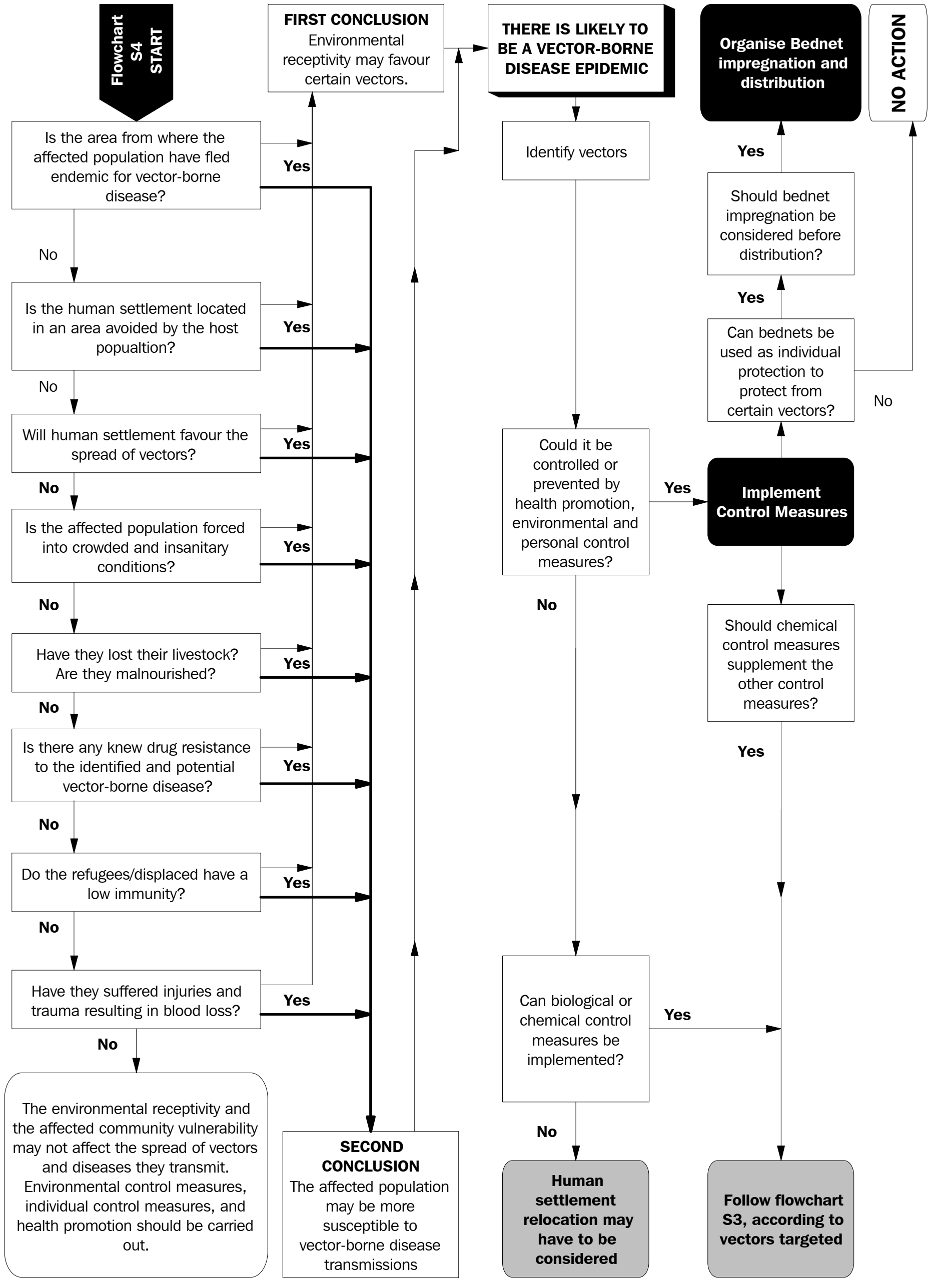
In order to plan a programme, the objectives and the control method options must be clearly defined. Also additional information needed such as the country's chemical regulations, logistical needs, available specialists and personnel related to vector control should be identified (see Flowchart S5).

4.4.3 Host country role and regulations

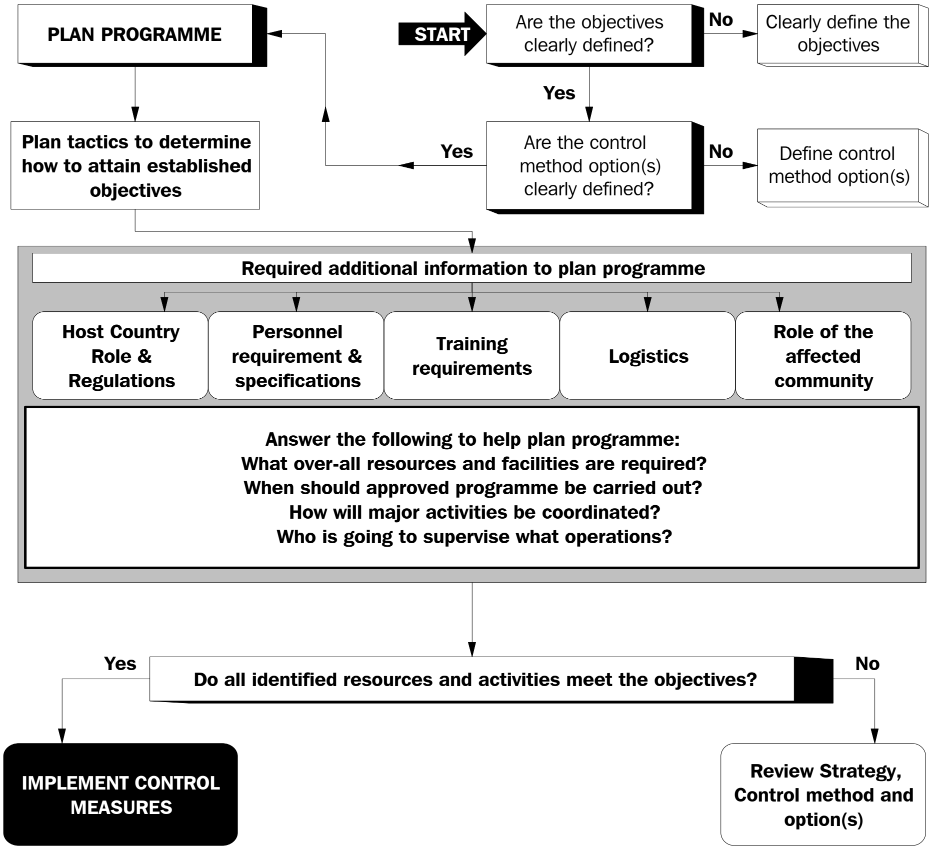
Before implementing any vector control project, the host government must be contacted. This could be the Ministry of Health, the Ministry of Agriculture, or any other department of the government involved in a vector control programme. Under circumstances where war occurs it may be difficult or impossible to approach them.



Flowchart S3. Chemical option strategy choice during epidemic



Flowchart S4. Flowchart for assessing risk of a community to risk of a vector-borne disease epidemic



Flowchart S5. Process to plan programme

The host country may have its own national control programme. Many countries in Africa, Asia, Americas and Europe have set up control programmes, but many of them are still without a national control programme, especially when the use of insecticides is required. Many countries cannot afford such a programme.

When consulting the host country authorities it is important to ask relevant questions such as :

- Is/was there a national control programme already in place?
- Is there information on identification of the targeted vector?
- Are there problems of resistance?

- Which insecticide is authorised by the regulations of the country?
- Where is equipment available?
- Are national experts and qualified personnel available for support?

Certain insecticides are no longer in use for agriculture, but under epidemic conditions authorisation from the host country may be required for their use in a public health vector control programme. In any case, only those insecticides designed for public health purposes should be used if available.

Under vector-borne epidemics the implementing organisation must be aware that the host government will normally only concentrate their resources on protecting their nationals from the disease rather than the refugees (Thomson, 1995).

4.4.4 Personnel requirement and specifications

Personnel recruited with previous experience in controlling vectors of medical importance or of agricultural importance will be a great advantage for vector control implementation.

Personnel at senior level should have at least a degree in science and/or health engineering, and labourers should have at least a basic education.

The number of personnel will depend on the gravity of the situation and the space to be treated. Personnel specifications are developed in Appendix 4.

4.4.5 Role of the affected community

The affected people, even if they are physically unfit and mentally traumatised, are very concerned with their own health, and therefore should normally be willing to provide information, assistance and personnel. Refugees or Internally Displaced People representatives may be very useful in providing, if available, people who have had previous experience in vector control programmes.

The community can be successfully involved within the control programme in providing information on man-made and/or natural potential breeding sites, in taking part in the monitoring project such as in preventive control measures, and in providing personnel from their community for implementation of projects.

4.4.6 Training needs

Suitable material and equipment should be identified for training courses. Training should be an integrated and compulsory part of a vector control programme. Even people with previous experience should have refresher courses on practical implementation of pesticide control programmes. Courses should be as practical as possible and adaptable to each person's level of qualification.

Training courses are developed in Chapter 5.

4.4.7 Logistic needs

The success of the control programme will also depend on the response of the logistics department in providing the required equipment, insecticides and other logistical support.

Reliable suppliers must be identified and located. The equipment and spare parts, personal protection such as clothing, and insecticides must be provided in enough quantity to cover the surface area to be treated, and for the duration of the control programme.

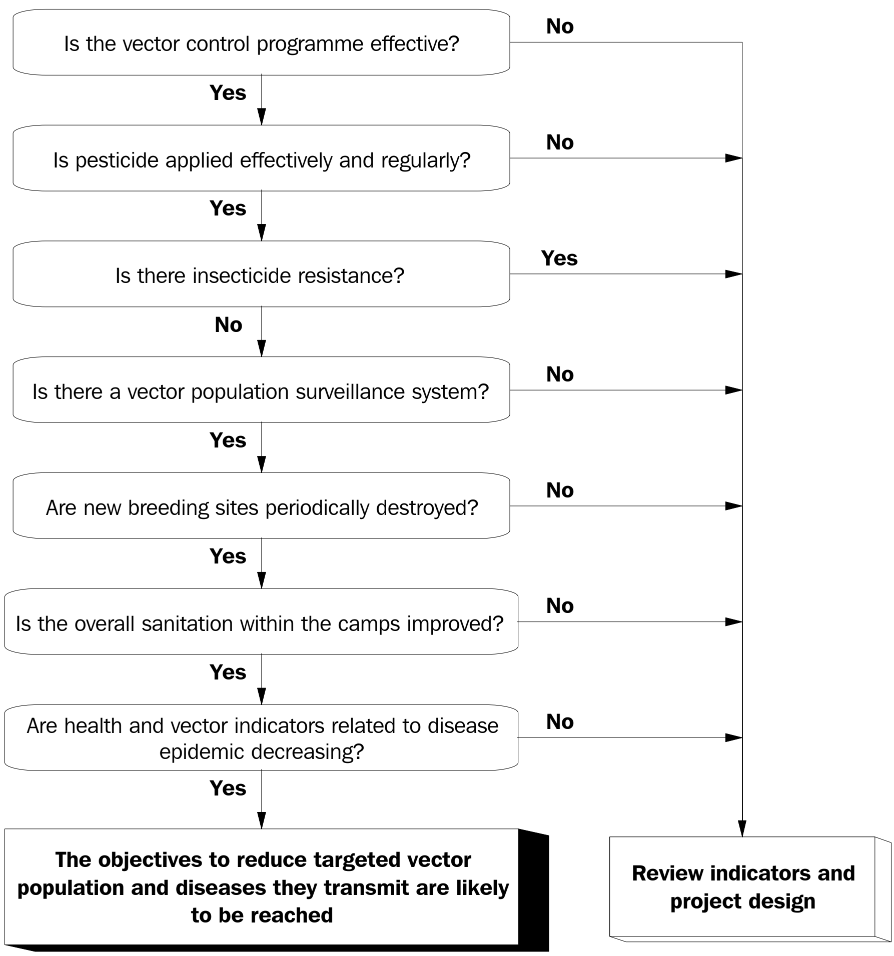
International orders may take several weeks or months, and once in country may be held up by customs, which could delay the projects. Good logistical support is vital to sort out such problems should they arise.

The site of the vector control centre must be discussed with the local authorities and the camp representatives. It must be located at least 1 km from any settlement. The material needed for the construction of the control programme centre must be identified. The construction includes a warehouse for storing the pesticides and machinery, an area for cleaning the equipment, water and hygiene facilities for the personnel, soakaway pits for disposal of the polluted water, and another water facility for the preparation of the solutions.

The transport of the personnel, equipment and the chemicals must be clearly defined according to the regulation of the host country and international regulations.

4.5 Operational implementation *(Flowchart S2)*

Water and sanitation engineers, public health engineers, and sanitary engineers have to manage and plan operational activities. These include required specific schedules for each activity; choosing site and construction of the vector control centre, determination of number of personnel and their individual assignments, personnel recruitment, training, purchasing spray equipment and insecticides, execution of the spraying campaign, continuous provision of service (operation and maintenance), monitoring of project results (evaluation), and preparation of progress reports. Practical Implementation is developed in Chapter 5.



Flowchart S6. Simple questionnaire survey for programme evaluation

4.5.2 Monitoring and evaluation

Under the circumstances prevailing in an emergency refugee/displaced person camp, the epidemiological data recorded in the health centres and the counts of targeted vectors constitute the best sources of information needed for a small and simple survey. Although that data may not be completely accurate for any number of reasons, these will at least give a trend of diseases occurring and the vector population needed to be targeted (Thomson, 1995). A system of surveillance should be carried out to monitor the programme by the collecting of data and information at least once a week.

Flowchart S6 should guide the field engineer with appropriate questions to evaluate the control programme.