1 Vector-borne diseases and refugees

1.1 Introduction

1.1.1 Refugee populations

Today more than 20 million refugees in countries throughout the world are dependent on international relief assistance. This number has risen dramatically over the last ten years, particularly in Africa, and, sadly, is likely to continue to do so. In addition to refugees, there are large numbers of internally displaced persons in countries such as former Yugoslavia, Rwanda, Afghanistan, Sudan, Ethiopia, Cambodia and Iran. There are over a million displaced people in Central America.

At least 80 per cent of registered refugees and displaced people are living in tropical or semi-tropical countries where vector-borne diseases, such as malaria, dengue, kala azar and sleeping sickness, are common and can have a high case-fatality rate if left untreated.

Outline of this book

The intention of producing these guidelines is to provide refugee relief workers with an overview of the problems associated with vector-borne diseases that they are likely to encounter, and a range of strategies for dealing with them. The type of information required for decision making on vector-control activities is described in section 1, and examples given of the management structures needed for an effective campaign. The major vector-borne diseases

1: The term 'refugee' is strictly defined by international law. It is used throughout these guidelines in a wider sense to include those fleeing from both war and famine, as well as those displaced within their own country.
and methods for their control are described in section 2. Section 3 presents community-based strategies for vector control. The choice and safe handling of insecticides is outlined in Section 4; and the final section gives recommendations for selection of spraying equipment. In the appendices there is a list of recommended texts; training courses; sources of advice; and the addresses of manufacturers of insecticide, spray machinery, bednets, and insect monitoring equipment.

These guidelines are not meant to be comprehensive but should be a good starting point for those interested in developing and strengthening preventive health-care programmes in refugee camps.

1.1.2 Vector-borne diseases in refugee camps

Vector-borne diseases may be exacerbated in refugee populations for a number of reasons. In recent years *falciparum* malaria has been a serious cause of mortality in refugee camps on the Thai-Kampuchean border, in Pakistan, and currently in the Rwandan refugee camps in Zaire. It is particularly dangerous when refugees who have not been exposed to the disease before, and therefore have a low level of immunity, are forced to flee into a malarious area (for example, refugees from mountainous regions who flee into malarious lowland areas). Young children and pregnant women are particularly vulnerable to malaria and can suffer very high mortality as a result of infection.

Other vector-borne diseases that affect refugee populations occur as a result of crowded and unhygienic conditions. In recent years louse-borne typhus and relapsing fever have been found in refugee camps in Somalia and Sudan. Louse-borne diseases are not confined to underdeveloped countries, and louse-borne typhus was a major killer of POWs and concentration camp inmates in Europe during World War II. Louse-borne diseases are currently a major concern to health workers in former Yugoslavia.

There are several reasons why vector-borne diseases may represent serious threats to the health of refugee populations:

1. Refugees may lack immunity to a disease or the particular strain of the disease in the settlement area (e.g. malaria).
2. Refugees may have fled through an area infested with certain insect vectors (e.g. tsetse-flies — the vectors of human and cattle trypanosomiasis; sandflies — the vectors of kala azar).

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2: In these guidelines the term 'vector' is given to any insect, tick, mite or rodent which transmits (carries) an infection from one animal or human host to another.
Disease prevention through vector control

3 Refugees may have settled on land uninhabited by the local population because of insect vectors (e.g. blackflies, the vectors of river blindness).
4 Refugees may have lost their live-stock (in which case insects which normally bite both humans and animals will feed more on humans).
5 Refugees may live in unhygienic and crowded camps where certain vector populations may dramatically increase. Shortages of water may exacerbate this (e.g. body lice, the vectors of louse-borne typhus and relapsing fever and filth flies which transmit diarrhoeal diseases and trachoma).
6 Stress resulting from flight, fear and loss may exacerbate disease morbidity (e.g. malaria) and may be part of a nutrition-infection-malnutrition cycle. Refugees may have suffered minor or major trauma resulting in blood loss, or be infected with intestinal parasites. The resulting anaemia may make malaria infection life threatening.
7 Such problems may be compounded by the breakdown of national vector control programmes in the areas from which the refugees have fled and in the host country. In the host country local resources may be overwhelmed by a sudden influx of refugees.

Vector control and public health measures
Prevention of vector-borne diseases through public health measures in a refugee setting may be more effective in reducing overall morbidity and mortality than curative care. However, all vector control programmes must be seen in the broader context of curative care, immunisation, and diagnostic facilities. Organisations interested in refugee health care should be aware of the risks of vector-borne epidemics, and prepare appropriate control strategies.

1.1.3 Definition of insect pests and vectors
Technical note: By scientific convention all creatures are identified by two names. The first (which always starts with a capital letter) is the 'genus' and the second the 'species' (e.g. Homo sapiens for humans). These specific names are written in italics and are frequently abbreviated with just the first letter of the genus being given (e.g for the mosquito Anopheles gambiae the abbreviated version is A. gambiae).

In order to carry out a control programme against disease vectors it is important to distinguish between those insects, mites, ticks and rats that are merely a nuisance, and those that are mechanical and/or biological vectors. Control programmes are of two kinds: those aimed at reducing a pest population and those aimed at reducing the likelihood of disease transmission. Since some disease vectors are also serious pests, these two categories may overlap.
Vector-borne diseases and refugees

*Nuisance pests*
It is their presence in large numbers that defines a pest population as a nuisance. Control measures are generally designed to reduce the pest population or reduce the pest-human contact.

*Mechanical vectors*
These vectors transmit pathogens by transporting them on their feet or mouthparts. A good example is the housefly that may carry worms, eggs or bacteria from faeces to food-stuffs on its feet and, in this way, transmit diarrhoeal diseases. Mechanical vectors are usually only one of several transmission routes (diarrhoeal diseases are commonly transmitted where there is poor hygiene). Control measures can be designed to reduce the vector population, and to reduce the likelihood of disease transmission, for example, by covering food stuffs.

*Biological vectors*
These vectors are intrinsically involved in the life-cycle of the parasite or arbovirus (a virus transmitted by an arthropod vector), which must pass through the vector in order to mature to an infective stage capable of being transmitted to its human host. The parasites or arboviruses are acquired from, and are transmitted to, a human or animal host when the vector takes a blood meal. Mosquito vectors are always female since the female mosquito requires a blood meal to mature her developing eggs. In the case of malaria, the parasite usually takes about ten days to mature in the body of the mosquito vector before it is ready to infect a new host. Thus only older female mosquitoes are capable of transmitting malaria.

Because of this, control strategies against malaria vectors can either be designed to reduce the overall population of the vector species, or to reduce the likelihood of the average female mosquito living long enough to transmit the disease.

Both males and females of several other biological vectors, such as tsetse, mites, ticks, and fleas, can transmit diseases, since both sexes feed on host blood. Biological vectors may be a serious threat to health even when their numbers are relatively low.

1.1.4 *Factors to be considered in vector-borne disease control*
Many different kinds of information will be needed before decisions are made about the need for vector control in a refugee camp: information about the disease problem, about the refugee society, about financial and other resources
Disease prevention through vector control

available, and about the wider implications of vector-borne disease control in relation to the host community. Some of the factors to be considered are outlined below.

**Diagnosis and epidemiological data**
In many refugee situations the diagnostic facilities are very limited. Information about the most likely causes of ‘fever of unknown origin’ (including vector-borne disease) should be sought from epidemiological data and clinical symptoms. The setting up of a field laboratory and, in particular, the training of microscopists, are vital components of an effective control programme.

Data should be collected on:
- Who is infected? (adults, children, males, females, new arrivals, old residents). This information may show whether or not transmission is occurring inside the camp.
- Where do the infected people live or work? If the disease is localised, the control programme can be localised too, so that the control effort has the maximum effect.

*The importance of training people to evaluate simple epidemiological data is shown in the following case studies: (from M. MacDonald, an entomologist, with UNBRO)*

‘...last August (1989) there was a frantic call from Site B that we must blast the camp with insecticides. The number of malaria cases seen at the hospital suddenly jumped from less than 100/month to over 500. But when we got up there and looked at the records we saw that all but two dozen were young adult males. It was obvious that there was not an outbreak of malaria within the camp (In Sok Sann camp a number of children were shown to have malaria)....when we ....plotted the distribution of P.falciparum cases in children under 14 we saw that there was a concentration in two sections of the camp. We made sure these sections were well covered with DDT spraying and did some night time barrier spraying with Deltacide and the cases amongst the children dropped.’

**Identification and monitoring of vectors**
An overall view of the likely pests and vectors to be found should be made on the basis of the known geographic distribution and ecology of the vectors. Within the camp environs, some vector species can be identified using simple reference texts or, if possible, with the help of a vector specialist.
Once the vector has been identified, it should be carefully monitored. *Pests* are easy to monitor, as their nuisance value is directly proportional to their numbers. *Vector species* may produce considerable levels of disease even when in relatively low numbers. Monitoring of vector populations by catching the insects when they come to bite people, or when they are resting, or by using some form of trap, will provide essential data on the locality of transmission: for example, are people being bitten while they sleep? Provision should be made for purchasing monitoring equipment. The population levels of certain vector species are closely associated with local climatic changes: rainfall, temperature, and humidity. Rainfall data in particular can be useful in predicting increases in vector populations.

**Control strategy in a crisis**

The level of response will depend on the seriousness of the situation. Does the epidemic cause a high mortality or morbidity when compared with other health problems? Many vector control programmes in refugee camps are introduced in response to a crisis. Being prepared for such eventualities will make the response much more effective.

By waiting for a crisis to occur before planning a control programme a delay is inevitable and makes it more likely that unsuitable insecticides will be used, because they are the only ones available. Items ordered from overseas may be delayed in customs for long periods. Spare parts for application machinery may take months to arrive and so a selection should always be bought at the time the machine is purchased.

In many cases where vector-borne diseases become a problem there is a ‘let us spray everything’ mentality. Spray programmes should always be regarded as an adjunct to other control methods (health education, sanitation, environmental health, biological control methods); although, in acute situations, a spraying programme can be initiated prior to any other control activity. Such a programme may be effective in the short term but is unlikely to be successful in the medium to longer term unless other control measures are also utilised.

**Sociological factors and public education**

While spraying might be a vital component in an emergency, there are important questions to be asked *before* commencing a control programme. Besides the epidemiological data to determine who is affected, there are sociological factors which need to be taken into consideration at the planning stage. Different cultural habits (such as purdah), and economic factors
Disease prevention through vector control

(availability of cash income) will affect the outcome of a control programme. For example, insecticide treatment of women for lice control may be resisted; bednets may be exchanged for other items regarded as ‘more valuable’ by the refugees.

Public health education is a major tool in controlling vector-borne disease but is often neglected until a control programme has failed. All vector control programmes require at least the passive if not the active support and involvement of the refugees themselves. Residual spraying of insecticide in dwellings may be refused or washed off if the public are not informed and motivated. Informing refugees about vector-borne diseases, and training them in vector control, can also contribute to health care in the future. Providing information on the hazards of insecticides is also important.

Cost of control programme and choice of insecticide
Control programmes are rarely cheap, although they may be more cost effective than expensive curative programmes. Quality equipment and insecticides bought from well-known firms may be more expensive in the short term but they are recommended because in the long run they are cost-effective and safer.

The choice of insecticides will be determined by various factors: ability to kill the target insect; availability and registration in the country; formulation for particular application method; safety to humans and the environment; and cost.

The use of inappropriate insecticides is not only wasteful of precious resources but may be hazardous too.

Monitoring of programme
When a control programme is introduced, arrangements should be made to monitor its effectiveness. Poor coverage and application practices are two of the main reasons for the failure of control programmes. Many NGO’s have a very short ‘organisational memory’. Careful monitoring of a vector control programme will enable costly mistakes to be rectified and future programmes to be justified.

Justifying vector control programmes
The quality of health care in a refugee settlement is often superior to that provided to nationals in the host country. This may result in resentment on the part of local residents towards the refugees, and may also undermine the national health infrastructure.
The problems associated with providing refugee populations with health care facilities that are unavailable to the national population have been pointed out by Meek (1989):

'Control of malaria in sub-Saharan Africa is different from south-east Asia in that the frequency of infective bites per person is in many places so high that drastic reductions in mosquito populations would be needed to have any effect at all. Furthermore, very little malaria control is carried out in many African countries because of lack of resources and logistical capacity. It is, therefore, difficult to justify measures in a refugee camp which are not available in the host country, unless the incidence in the camps can be shown to be higher.'

NGO's working in such situations need to take these wider political considerations into account when deciding on a strategy for health care. There are several good reasons which can be put forward to the host community, to justify setting up a vector control programme:

1 Control is part of the national health strategy in the host country.
2 The refugee vector control programme is to be extended to the host community.
3 The level of disease in the refugee community is greater than that in the host community.
4 There is a risk of epidemics.
5 Disease or drug resistance may spread from the refugee community to the host community.
6 Disease or drug resistance may spread from the refugee community to their home community on repatriation.

1.2 Decision making in vector control

1.2.1 The basis of decision making

The vector-borne diseases found in refugee settlements will include those found in the local population as well as those generated by the unhygienic and overcrowded conditions that may be found within the camp. A number of key questions should be asked when deciding to undertake a vector control programme in a refugee camp:

• Is the vector-borne disease important in relation to other health problems?
• Is the disease being transmitted in or around the camp?
Disease prevention through vector control

- Are vector control measures likely to have an effect?
  If the answers to the last two questions is ‘yes’, then the next question is:
- What is the most efficient control strategy to adopt?

Relative priority

The relative priority of the vector-borne disease will depend on the threat of morbidity and mortality. Camps set up during an emergency for refugee or displaced people are characterised by two main phases:

The acute phase: this usually lasts 1-12 months depending on the initial health status of the refugees and the effectiveness of the relief organisation.

The chronic phase: the morbidity and mortality experienced by the refugees may be similar to that of the local population, depending on availability of basic services, degree of crowding, etc.

In some recent refugee emergencies the overall mortality in the acute phase has been up to 60 times the normal rate; and this is based on what is ‘normal’ in some of the world’s poorest countries, where child survival is already extremely low. In the acute phase the importance of vector control must be assessed in relation to all the other inputs needed to sustain life.

The vital inputs required during the acute phase of a refugee emergency are:
- water, sanitation and shelter
- food distribution and nutrition interventions
- immunisations
- basic curative care (including surgery in a war zone).

and, in certain situations, vector control.

Situations when vector control is a priority

In certain circumstances, when there is a high threat of mortality or severe morbidity from a vector-borne disease, then vector control will become a priority. Vector control is warranted during the acute phase of a refugee emergency if any of the following conditions apply:

1. If the actual or threatened mortality rate from the disease is high and transmission is likely to occur in the camp; for example, where a large proportion of non-immune refugees are arriving in a camp where *falciparum* malaria transmission is likely to occur.

2. If the threatened mortality from the disease is high, the conditions exist for an epidemic, and the control is relatively simple. For example, louse-borne diseases are likely to reach epidemic proportions months after the setting up of a camp but mass delousing campaigns at reception centres and while
registering can greatly reduce the threat of an epidemic.

If there is a vector-borne epidemic in the locality which can result in a high mortality rate; for example, if there is a dengue haemorrhagic fever epidemic within the country and there is a likelihood of it spreading to the camp.

In the chronic phase, the need for vector control should be decided on the basis of the threat of morbidity, mortality, and the nuisance value of the particular insect.

**Threat of morbidity and mortality**

The main factors affecting the mortality rate caused by a vector-borne disease are:

- immune status of the population (i.e. proportion of non-immunes, under fives, pregnant women)
- current health status of the population
- virulence of the parasite or virus
- availability and effectiveness of curative treatment.

The importance of vector control will depend on what other preventative and curative measures are available. The threat of mortality and morbidity from vector-borne diseases, and the methods for prevention and treatment are shown in Table 1.

**Transmission**

If the disease is not being transmitted within the camp then vector control efforts will be ineffective. Some diseases have a long incubation period. In a moving population it can be hard to tell where the infection was picked up. Immediate information should be sought on whether the vector is present in or near the camp; and whether epidemiological information supports the theory that transmission is occurring in the camp. For example, useful questions would be:

- *Have the infected people, that have fallen sick while in the camp, been in the camp for longer than the incubation period of the disease?*
  
  If the answer is ‘yes’, then the disease is being transmitted in the camp.

- *Is the infection limited to new arrivals, or those that spend considerable time outside of the camp (e.g. men who are also fighters)??*
  
  If the answer is ‘yes’, then the disease is being transmitted outside the camp.

Training health and sanitation staff to use epidemiological data to aid their choice of strategy will greatly improve the efficacy of any control measure undertaken. However, epidemiological data should be treated with caution, as there may be gender differences in reporting sickness to clinics; women in particular may be unable or unwilling to make use of health services, and their illnesses may be under-reported.
## Table 1 The threat of mortality and morbidity from vector-borne diseases

<table>
<thead>
<tr>
<th>Vector</th>
<th>Disease</th>
<th>Mortality and morbidity if untreated</th>
<th>Prevention and treatment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>mosquitoes</td>
<td>malaria falciparum</td>
<td>often fatal to non-immunes, can be fatal</td>
<td>drug therapy (resistance); vector control; environmental management; residual spraying; bednets</td>
<td>non-immunes, children and pregnant women are extremely vulnerable. Explosive epidemics can occur</td>
</tr>
<tr>
<td></td>
<td>malaria vivax</td>
<td>rarely fatal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>malariae</td>
<td>rarely fatal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ovale</td>
<td>rarely fatal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yellow fever</td>
<td>fatal in 80% of severe cases</td>
<td>vaccination; isolation under bednets; vector control</td>
<td>monkey is the natural reservoir. Vaccination is primary form of prevention</td>
</tr>
<tr>
<td></td>
<td>dengue</td>
<td>not fatal</td>
<td>isolation under bednets; vector control</td>
<td>affects mainly non-caucasian children under 12 years old; epidemics occur when non-immunes enter endemic area</td>
</tr>
<tr>
<td></td>
<td>dengue HF</td>
<td>fatal in 10-20% of cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>fatal in 0.5-60% of cases</td>
<td>vaccination; isolation under bednets; vector control</td>
<td></td>
<td>Transmitted from infected animals</td>
</tr>
<tr>
<td>filariasis</td>
<td>not fatal – elephantiasis (blocking of lymph ducts)</td>
<td>drug therapy; vector control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>other arboviral infections</td>
<td>not fatal</td>
<td>isolation under bednets; vector control</td>
<td></td>
<td>Occasional occurrences or epidemics</td>
</tr>
<tr>
<td>lice</td>
<td>typhus</td>
<td>fatal in 10-40% of cases</td>
<td>antibiotics; change of clothing; delousing</td>
<td>Characteristic of refugee populations crowded together in unhygienic conditions</td>
</tr>
<tr>
<td>Disease Type</td>
<td>Incidence/Severity</td>
<td>Treatment/Prevention</td>
<td>Characteristics</td>
<td></td>
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<tr>
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<tr>
<td>Relapsing fever</td>
<td>Fatal in 2-10% of cases</td>
<td>Antibiotics; change of clothing; delousing</td>
<td>Characteristic of refugee populations crowded together in unhygienic conditions</td>
<td></td>
</tr>
<tr>
<td>Trench fever</td>
<td>Not fatal</td>
<td>Antibiotics; change of clothing; delousing</td>
<td>Characteristic of refugee populations crowded together in unhygienic conditions</td>
<td></td>
</tr>
<tr>
<td>Filth flies</td>
<td>Diarrhoeal disease</td>
<td>Primary killer of under 5's</td>
<td>May be an important transmission route</td>
<td></td>
</tr>
<tr>
<td>Eye disease (trachoma)</td>
<td>Not fatal – severe eye impairment including blindness</td>
<td>Antibiotics; hygiene/sanitation; vector control</td>
<td>May be an important transmission route</td>
<td></td>
</tr>
<tr>
<td>Tsetse flies</td>
<td>Gambian sleeping sickness</td>
<td>Death after years of infection</td>
<td>Sporadic human disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rhodesian sleeping sickness</td>
<td>Death within weeks of infection</td>
<td>Cattle trypanosomiasis (nagana) very important disease of cattle in Africa; human disease sporadic with occasional epidemics</td>
<td></td>
</tr>
<tr>
<td>Sandflies</td>
<td>Sandfly fever</td>
<td>Not fatal</td>
<td>Similar to about 80 other arboviral fevers transmitted by mosquitoes, sandflies, ticks.</td>
<td></td>
</tr>
<tr>
<td>Vector</td>
<td>Disease</td>
<td>Mortality and morbidity</td>
<td>Prevention and treatment</td>
<td>Notes</td>
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<tr>
<td>----------------</td>
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<tr>
<td>cutaneous</td>
<td>leishmaniasis</td>
<td>not fatal: severe skin lesions</td>
<td>drug therapy; vector control</td>
<td>may be epidemic in populations displaced into areas where animal reservoirs are common but may also be transmitted directly between humans.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>visceral</td>
<td>leishmaniasis</td>
<td>fatal in 100% of cases</td>
<td>drug therapy; vector control</td>
<td>as above; epidemics are associated with social dislocation due to war/famine.</td>
</tr>
<tr>
<td>blackflies</td>
<td>onchocerciasis (river blindness)</td>
<td>not fatal – visual impairment, itchy skin, veru debilitating</td>
<td>drug therapy; vector control</td>
<td>blindness is more common in the savannah areas of West Africa than in the forest areas.</td>
</tr>
<tr>
<td>ticks</td>
<td>Crimean Congo HF</td>
<td>fatal in 2-50% of cases</td>
<td></td>
<td>transmission usually localised.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mild form Central Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>severe form Central Asia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mites</td>
<td>typhus</td>
<td>fatal in 1-60% of cases depending on strain</td>
<td>antibiotics; repellents; insecti-cide impregnated; clothing</td>
<td>transmission usually localised – affects those who work in the bush (agriculturalists, military, hunters)</td>
</tr>
<tr>
<td>triatominbe bugs</td>
<td>chagas disease</td>
<td>not immediately fatal; chronic debility</td>
<td>bednets; vector control</td>
<td>disease associated with poor housing</td>
</tr>
<tr>
<td>fleas</td>
<td>murine typhus</td>
<td>fatal in 2% of cases</td>
<td>antibiotics; vector control</td>
<td>occurs in unhygienic conditions with a large rat population</td>
</tr>
<tr>
<td>plague</td>
<td>bubonic pneumonic</td>
<td>fatal in 60% of cases</td>
<td>strict isolation; antibiotics; vector control</td>
<td>occurs in unhygienic conditions where there is a large rat population</td>
</tr>
</tbody>
</table>
In many situations it may be extremely difficult to determine where transmission is occurring. It may be necessary to maximise the use of minimal data. The scale of the control programme required to reduce transmission of a particular disease will depend on the dispersal range of the vector. A list of useful references on the epidemiology of vector-borne diseases is given at the end of this book.

1.3 Organisation of a control programme

Control programmes vary greatly in their complexity and effectiveness. Successful vector control programmes depend on well-informed, properly co-ordinated activities of a large enough control team, using appropriate and efficient control methods. Essential to such a programme is proper supervision to ensure that the measures are being carried out correctly, and an operational evaluation of the control methods to make sure that the objectives have been achieved.

1.3.1 Matching a control strategy to available resources

There are often a number of different strategies that might be adopted to control a particular vector. In the case of malaria, for example, possible strategies might include: destroying mosquito breeding sites; residual spraying with insecticide; or the provision of insecticide-treated bednets. Cost-benefit analysis can help in deciding which is the most appropriate method. This involves assessing and then comparing the effectiveness and the cost of differing control strategies. The purpose is to identify how to arrive at a specified objective at least cost; in other words, how to achieve the best results within a given budget. A guideline to this approach has been prepared by the WHO/FAO/UNEP/UNCHS Panel of Experts on Environmental Management for Vector Control: Phillips, M, Mills, A, and Dye, C (1993) Guidelines for cost effectiveness analysis of vector control.

The role of the host government

The largest refugee populations in the world today are in countries where the annual expenditure on health is extremely low. In these countries, national vector control programmes are rare, and, if they exist, usually face a permanent shortage of qualified personnel, transport, and funds. The appropriate government ministry should be consulted prior to the setting up of a control programme (particularly if it involves the use of insecticides). However, the
contribution that a ministry can make to the control programme will vary according to its own technical capacity at the time of the disease outbreak. During an epidemic, government resources may be over-stretched in protecting their nationals from the disease, and in such circumstances, NGOs may play an extremely important role. In a situation where the population has been displaced as a result of civil war it may not be possible to gain the support of the national government for a control programme.

National vector control programmes are often structured as vertical, single disease, control programmes (such as a National Malaria Control Programme). The advantage of vertical programmes in vector control is that the timing of an intervention (such as a spraying campaign) is often crucial; and vertical programmes may have more flexibility in ensuring a rapid response than a primary health care approach would have.

The role of International Organisations (IOs)
The Emergency Technical Cooperation Unit of the World Health Organisation (WHO) is committed to assist in emergency relief, including vector control, and may be able to procure, at short notice, insecticides, spraying equipment, protective clothing, and sanitation equipment. Expert advice and short-term consultations may be provided by WHO if requested through the Ministry of Health of the host government. Other international organisations with experience in vector control include the United Nations High Commission for Refugees and the International Commission of the Red Cross (ICRC).

The role of NGOs
The role of an NGO in a vector control programme will vary according to the particular situation and the level of involvement of the NGO in the overall running of health facilities within the refugee camp. NGO staff must make sure that they are aware of any national guidelines for vector control. The main areas of assistance that the NGO might provide are:

- access to technical expertise, by liaising with relevant IOs, government departments, academic or research institutions concerned with vector-borne diseases, and other NGOs; providing their own experienced personnel; employing consultant vector specialists; getting access to relevant international literature;
- funding of part or all of a vector control programme; in particular, funding for fuel, transport, salaries of spray personnel, insecticide, bednets, and equipment needed for environmental sanitation, such as spades, tractors, and garbage containers;
• running the vector control programme; in which case the NGO personnel must be aware of all aspects of vector control, including the need for planning and inter-sectoral collaboration.

The role of an entomologist (vector specialist)

The assistance of an entomologist (vector specialist) may be needed where vector control operations are being started. Local expertise should always be the first to be consulted. If national experts are not available then an expatriate consultant should be recruited. Organisations from which vector specialists might be recruited are listed in Appendix 1.

If a suitably qualified vector specialist is not available then a capable person, preferably a biologist, with the assistance of reliable reference texts and a hand-lens, should be able to identify the major pest groups. The texts listed in the references at the end of the book are useful in the identification of vector species.

The tasks of a vector specialist are:

1. **To predict the likely vector problems.** The advice of a vector specialist should be sought when a camp is being established, in order to reduce the likelihood of siting the camp in a vector transmission zone, and to help to prepare control strategies in case the need arises.

2. **To identify the vector.** This may be particularly important in areas where there is no national vector control experience, and the specific mosquitoes responsible for malaria and viral diseases are not identified. In many areas of the world, the main vectors responsible for malaria have been identified, and their ecology and behaviour investigated.

3. **To locate the breeding sites of the vector.** This may be the most important function of a vector specialist, who will then be able to train other people in recognising vector habitats.

4. **To test insecticide susceptibility.** Insects can either be collected in the field and sent to a laboratory for testing or the tests may be undertaken by a skilled person under field conditions.

5. **To help to design the control programme** and train the vector control supervisors.
1.3.2 Evaluation and monitoring of vector control

Maps
A careful map of the refugee camp and its surrounding area (up to 2 km away if the security situation permits) at a scale of about 1:5000 should be made which shows all the individual sites which may be breeding grounds for insect vectors or rodent pests. A complete inventory of the type and location of all such sites should be made and used to provide a record of the time each site was inspected or treated.

An example of how breeding sites can be identified and controlled was given by an entomologist working in refugee camps in Sudan, who noted that mosquito breeding sites were localised, man-made and therefore easy to control: ‘(Several mosquito breeding areas were identified) .... in every case these were associated with the water supply (in particular the leaking water towers). ...the tukels closest to the tower were identified as one of the worst areas for cases of malaria in the settlement.’ (C. Malcolm, Consultant Entomologist, UNHCR Eastern Sudan 1988)

Recent advances in the use of satellite data make remotely sensed images a possible method for mapping uncharted areas. The Famine Early Warning System provides ‘real time’ satellite data which indicate the amount of plant growth in an area (which can alert authorities to potential famines). Rainfall data can be obtained from weather monitoring satellites, and high resolution images can be used for mapping.

Pest and vector surveys
Vector surveys are used to determine if insect or rodent pests and vectors are present. To do this the vector surveyor must be able to interpret signs of insect or rodent infestation and be able to identify which species are present. Monitoring should take place on a regular basis (once a week for larval mosquitoes) during the normal transmission season. Simple record sheets should be prepared on which to record the type of survey, the date, time, area, and the insects collected.

Surveys may involve active searches for insects and rodents, the use of bait or light traps, or the capture of insects attracted to feed on humans or animals. Such collections must be made regularly to monitor the abundance and type of vector or pest present. The addresses of manufacturers of insect traps are given in Appendix 2.
Vector-borne diseases and refugees

Since malaria mosquitoes usually bite at night, surveying adult mosquitoes in a refugee settlement is often made difficult by the lack of access to the camp at night to collect mosquitoes. Unless well trained and motivated refugees can be found to make such collections, insect traps, which can run with little supervision, or early morning spray collections, may be more appropriate.

Operational indicators
A simple list of operational indicators for a particular control programme should be made and kept up to date (see Table 2 for an example of operational indicators for malaria mosquito control).

Evaluation and monitoring of epidemiological information
Under the conditions prevailing in a refugee camp epidemiological information is best gathered by a small sample survey. This is often far more reliable than that emanating from a deficient universal coverage system; another advantage is that the results of a sample survey are rapidly available. Sample surveys may be based on records of hospitals, clinics, dispensaries. These data, even if biased by various factors, may indicate trends in the epidemiology of the disease. Most diseases vary seasonally, and samples should be carried out systematically throughout the transmission season. There are a number of reference texts which cover the procedures used to conduct epidemiological surveys and analyse their results, some of which are given in the references at the end of the book.

1.3.3 Training of the vector control team
The personnel required for a vector control team, and the level of training likely to be necessary are shown in Table 3.

On-the-spot training of sanitation workers and supervisors should be a regular and continuous feature of the vector control team. Even experienced workers should have annual refresher courses in control operations, public education, and insecticide safety. Such courses should be as practical as possible. Suitable written material and posters should be produced in the appropriate language.

Training manuals and course materials for senior and junior field staff should be obtained and adapted for local use. WHO produce a training manual for field staff working on a malaria control programme; another manual is provided for their tutor. GIFAP produce training material for users of agricultural pesticides which could be adapted for a vector control team. ‘Home study’ training courses
<table>
<thead>
<tr>
<th>Operational Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor residual spraying</td>
<td>Percentage of structures totally or partially covered in relation to target. Refusal rate, spot check of dosage and date of application of insecticide. Assessing and monitoring the susceptibility of vectors to insecticide.</td>
</tr>
<tr>
<td>Space spraying indoor and outdoor</td>
<td>Frequency and regularity of application. Coverage of applications. Timing of application. Assessing and monitoring the susceptibility of vectors to insecticide.</td>
</tr>
<tr>
<td>Larviciding operations</td>
<td>Assessing and monitoring the susceptibility of vector larvae to insecticide. Frequency, regularity and dosage of larviciding application. Estimated area covered and percentage of population protected. Regularity and coverage of entomological evaluation.</td>
</tr>
<tr>
<td>Environmental modification</td>
<td>Indication of the type and size of the operation, and the stage of development. Estimated percentage of population protected. Regularity and coverage of entomological monitoring.</td>
</tr>
<tr>
<td>Screening of houses</td>
<td>Percentage of dwellings screened. Degree of screening (partial or complete). Percentage of population protected.</td>
</tr>
<tr>
<td>Bednets, repellents</td>
<td>Random sampling survey to assess whether bednets or repellents are properly used. Frequency of use. Condition of bednets. Acceptability of repellents. Percentage of population protected. Percentage of most vulnerable groups protected.</td>
</tr>
<tr>
<td>Entomological laboratory and field</td>
<td>Percentage of trained field entomologists employed. Percentage of training undertaken. Number and frequency of entomological surveys undertaken in relation to plan.</td>
</tr>
</tbody>
</table>
**Table 3 Personnel required for vector control team**

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Tasks</th>
<th>Training required</th>
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<tbody>
<tr>
<td>Public Health Officer/Chief</td>
<td>To assess vector problem, liaise with national and international experts if necessary, plan control programme, monitor control operation using entomological and operational indicators, train vector control supervisors, liaise with medical personnel and water engineer and instruct administrator.</td>
<td>Should already have training in public health including general vector control principles. If additional training is required then should attend national training course if available, inter-camp training course that may be set up or, if an expatriate, may attend short courses in vector control prior to arrival in country. Should have access to relevant literature and advice.</td>
</tr>
<tr>
<td>Sanitarian/Vector Control Officer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrator</td>
<td>To organise logistics of control programme, including employing sanitation/spray personnel, organising availability of transport, fuel, insecticide, shovels, camping equipment for field team if necessary, training programme of field staff.</td>
<td>Should be aware of importance of a particular vector problem, the need for timely interventions and the specifications for purchasing good quality bednets, insecticides, spray machinery. Should organise budget and account for moneys spent.</td>
</tr>
<tr>
<td>Supervisor</td>
<td>To inspect work, fill out operational indicator forms, identify current or potential vector breeding sites, identify vector groups (such as anopheline mosquito larvae) train sanitation/spray personnel. One supervisor for every 6-10 sanitation/spray workers.</td>
<td>3-week training covering general theory of vector control, identification, of vector, breeding and resting sites, health education, training of sanitation workers, supervision, including filling in forms of operational evaluation, maintenance of spray machinery, safe use of insecticides.</td>
</tr>
<tr>
<td>Sanitation/spray personnel</td>
<td>Draining swampy area, assisting in latrine building, residual spraying of insecticide. May be permanent or temporary staff.</td>
<td>3 days’ practical training in control techniques, simple health education, safe use of insecticides. The methods of operational evaluation and supervision should be clearly explained.</td>
</tr>
<tr>
<td>Water engineer</td>
<td>Assistance with environmental sanitation, and the design and maintenance of water supply systems.</td>
<td>Should have access to relevant literature on vector control and to advice where necessary.</td>
</tr>
<tr>
<td>Medical personnel</td>
<td>Assess threat posed to refugee population by vector-borne disease and provide suitable epidemiological data from sample survey of refugee population. May liaise with Ministry of Health, national and international centres of expertise.</td>
<td>Should have familiarity with using health data to assess needs. Should have access to relevant literature and advice where necessary.</td>
</tr>
</tbody>
</table>
in entomology and epidemiology are available from the Centre for Disease Control (Atlanta, USA). These courses consist of a combination of lessons, manuals, outside reference material, and practical exercises, and proficiency and comprehension can be tested. CDC and WHO also produce a wide range of slide collections, covering a range of subjects related to vector-borne disease transmission and control, which can be used in training sessions for staff. A series of four-page technical briefings on health, water, and sanitation have been produced by the Intermediate Technology Centre.

Short courses may be available at certain institutes; such as the two-day louse and scabies eradication course run at the Medical Entomology Centre in Cambridge, or the course at the Liverpool School of Tropical Medicine course on community health in developing countries.