Malaria Control among refugees and displaced populations

by

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FOREWORD

The purpose of these guidelines is to help agencies such as the Office of the United Nations High Commissioner for Refugees (UNHCR), and other organizations and nongovernmental organizations (NGO)'s that provide assistance to refugees and displaced populations in tropical countries, to manage the malaria problems encountered in such situations.

It should be borne in mind that malaria is only one of the many public health problems that require urgent attention in a crisis situation. These guidelines should be used as a complement to the more general guides on assisting and providing health care for refugees that are issued by the various agencies. Malaria control poses problems that are often rather complex and do not respond to simple interventions of general applicability.

Malaria is by far the most widespread of the so-called tropical diseases. Together with malnutrition, diarrhoea, acute respiratory infections and measles, it is one of the most common health problems of displaced populations.

In recent decades most endemic countries have changed their strategy of malaria control, as a result of the failure of the global malaria eradication programme which dominated the planning of antimalaria activities during the 1960's. A Global Malaria Control Strategy was adopted by the Ministerial Conference on Malaria held in Amsterdam in 1992 (WHO, 1993a), but there is still some confusion among general public health workers as to the short- and long-term effects that result from various antimalaria interventions.

An essential element of the Global Malaria Control Strategy is the recognition of the variability of local malaria problems and, therefore, of the need to adapt control interventions to local variations. Malaria control among refugees and displaced populations requires similar adaptability, complicated by the emergency situation and the general lack of material and human resources. These guidelines are designed to assist public health authorities in selecting malaria control activities adapted to such situations.
Because of the variability of malaria problems, it is difficult to lay down clearly prescriptive guidelines, and yet to provide advice that will be generally useful and understandable to non-specialized public health workers.

These guidelines are not intended to replace the involvement of specialists, particularly for the planning and implementation of transmission control interventions. Their main purpose is to facilitate understanding of the malaria problem and communication between generalists and specialists when antimalarial activities that go beyond the simple management of disease must be envisaged.

These guidelines may also serve as a reminder to specialists of a number of problems peculiar to the situation of refugees and displaced populations that lie outside the experience of many malarialogists. Thus they describe such problems, and the common ordeals suffered by refugees, in a way that may appear somewhat simplistic to personnel engaged in relief work.
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1. INTRODUCTION

The continuous increase in the numbers of refugees and displaced persons during the last two decades, with its dramatic consequences of hunger, stress, infection and death, has been described as a symptom of the ills of our times (UNHCR, 1993).

UNHCR has estimated that in 1993 the number of refugees sensu stricto had reached 18.2 million, to whom 24 million people displaced within their own countries should be added. Perhaps the most disturbing feature is the overall trend in the problem, the scale of which has grown considerably faster since the mid-1970s; while in 1978 there were 4.6 million refugees dependent on the assistance and protection of the international community, by 1993 there were four times as many (UNHCR, 1993; see Figure 1). Paradoxically, this growth has apparently increased after periods of relaxation of the major international tensions. Although the number of refugees sensu stricto has diminished in the last two years, the total number of displaced people continues to increase (UNHCR, 1995).

The conditions that force people to leave their homes and seek refuge elsewhere are often extremely violent and may be compounded with the destruction of homes and villages. In most cases refugees have to endure all kinds of deprivation during the period of displacement. When they are finally able to settle somewhere, they may not have any form of shelter until they are cared for by a relief agency.

As a result, refugees are highly vulnerable to health hazards. Recorded mortality rates in the first weeks of refugee settlement can reach levels of more than one for every 1,000 people each day, children under 5 years of age incurring the highest risk (Glass et al., 1980), and are often 30 to 60 times higher than the rate in the local population (Toole & Waldman, 1990). These very high rates are only an indication of the even more dramatic situation during the displacement period, when no information is recorded. Mortality rates often drop to about one for every 10,000 people a day during the first few months that some basic care is provided; further reductions are an indication of the adequacy of relief measures in meeting the basic needs for food, water, shelter, sanitation, immunizations - particularly against measles - and control of prevalent communicable diseases. In malarious or potentially malarious areas, the exposure to malaria transmission among refugees is several times greater than that of local people living under normal conditions.
Figure 1.

Number of refugees in the world (1960 - 1992)

Source: UNHCR (1993)
Malaria morbidity and mortality have always increased dramatically among refugees in tropical areas, because of the additional exposure mentioned above. Moreover, during the last decade the problem has become even more severe, and continues to worsen, as a result of the spread of resistance of *Plasmodium falciparum* to common antimalarial drugs throughout the world, which makes control more difficult.

The growing numbers of refugees and of episodes of massive exodus are a matter for serious concern for all international organizations, whether their focus is relief or development. In dealing with the problems of refugees, it must be recognized that each refugee problem is different; although the response should be guided by knowledge of the problems and past experience of dealing with similar situations, it should also be based on a rapid but thorough assessment of each concrete situation.

WHO has always been concerned with providing technical guidance to relief agencies, and has collaborated in planning, guiding and evaluating health care to refugees and in preventing or controlling epidemics following natural or social disasters. The increasing scale of the refugee problem and the general worsening of the malaria situation in recent years have prompted the preparation of this review and guidelines, which are intended to contribute to an understanding of the problem and the planning and implementation of locally relevant interventions.

1.1 Evolution of the refugee problem and relief action

After the First World War, international concern with refugees was directed towards legalizing the status and repatriating when possible, more than half a million prisoners of war and one and a half million refugees and displaced persons, as a consequence of the war, the Russian revolution and the collapse of the Ottoman Empire. The League of Nations created a High Commission for Refugees in 1921. After the Second World War, in 1947, the United Nations established the International Organization for Refugees, which was replaced in 1951 by the Office of the United Nations High Commissioner for Refugees, known as UNHCR. It was then expected that the problem of the one and a quarter million refugees created by and in the aftermath of the war would be a temporary one and that the main role of the organization would be to legalize their status, improve their health and facilitate, through negotiation and international collaboration, their integration into the societies that had received them. Their resettlement, considered necessary for the maintenance of
world peace, was also aided by the fact that European countries needed their technical and agricultural skills to help in postwar reconstruction (Simmonds, 1984). It was expected that after accomplishing that task the organization could be dissolved. UNHCR was therefore established initially for a period of three years.

Contrary to those expectations the number of refugees continuously increased throughout the period of the Cold War. As international political conflicts involving countries of the Third World became more frequent, they often resulted in mass exodus, while recipient countries seldom had the capacity to integrate the refugees into their economies. The sheer numbers and the slow procedures for finding permanent asylum resulted in the perpetuation of their state of waiting for settlement in a recipient country. Moreover, as already mentioned, the end of the Cold War did not result in a lessening of the refugee problem but, if anything, in its constant intensification.

These developments have been responsible for substantial changes in the scope of international relief, as well as in the concept of who is a refugee, and for the progressive involvement of development and political agencies in emergency relief operations. Some of these changes are summarized below:

(a) The objective of international protection for refugees changed from being predominantly a search for integration in the recipient country, or reinstallation in a third country, to that of temporary protection to be followed by a freely accepted repatriation when conditions in the country of origin no longer represented a threat; UNHCR has not proposed permanent integration as a solution of a large-scale problem since the 1960s (UHCR, 1993). The majority of refugees receive, therefore, only a temporary sanctuary, with the expectation that they will return to their areas of origin as soon as circumstances permit, even if that return may seem to be postponed indefinitely. This was the case with the tusi Rwandese refugees in Burundi, Kenya, Uganda, the United Republic of Tanzania, and Zaire, who were expelled during the social revolution of 1959 preceding independence in 1962. They did not start to return until the adoption of the Declaration of Dar es Salaam in 1991. Rwanda then underwent a civil war involving racial persecution with thousands of victims and a massive exodus of new refugees.

The assistance of international relief organizations has also been increasingly required for mass population displacements that do not strictly fit the concept of refugee.
(b) In keeping with these developments the definition of the term "refugee" has been progressively broadened. The 1951 United Nations Convention and Protocol Relating to the Status of Refugees referred to people having fled their country "owing to a well founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion"; the Organization of African Unity (OAU), in 1969, extended the definition to include people fleeing from war, civil disturbance, and violence of any kind (D’Souza, 1981).

In contrast many recipient countries, in defining and delimiting the rights of refugees, have focused on distinguishing political refugees from economical immigrants and have had a tendency to become increasingly restrictive. As a result the concept of refugee has different connotations when considered from different points of view.

(c) Although most definitions of the term, including those found in dictionaries, require crossing an international border, the experience of UNHCR and other agencies dealing with the problem has led to the extension of their scope to cover the problems of displaced populations, not only across international borders, but also within a single country. By the late 1980s, these populations were estimated to account for more than half of all displaced persons worldwide, but were virtually unprotected by international conventions.

(d) Emergency requirements similar to those of refugees arise in populations affected by natural disasters, such as hurricanes, floods and earthquakes, or by famine, resulting when problems of food production or economic collapse and loss of purchasing power hit population groups already affected by poverty, malnutrition and underemployment (CDC, 1992). Most of these situations are complicated by, or are the prelude to, civil disturbance or war, which may become the immediate cause of mass exodus and the creation of a refugee population. Repeated crop failures in Ethiopia, Somalia, Sudan and the Sahel have been attributed to progressive deterioration of the environment, including deforestation, desertification and poor agricultural practices; nevertheless most of the major population displacements of the past 20 years have been triggered by people’s fear for their lives caused by war or widespread civil disturbance (CDC, 1992).

The disruption of normal human habitats, which most of situations of this kind entail, considerably increases the risk of human/vector contact. The frequently long displacements may bring populations into areas where they may be infected by species or strains to which they are
not immune, or the refugees may introduce new parasites into the areas where they settle. Moreover, the disruption or collapse of most social structures that results from these events generally means the interruption of any malaria preventive service and, in most cases, shortage or unavailability of antimalarial drugs. Although these factors may nearly always be present to varying degrees, some may predominate in any given situation: for example, while displacements within very highly endemic areas would not produce a dramatic increase in overall parasite incidence, severe malaria and deaths may increase in children owing to lack of drugs, concomitant infections and malnutrition. On the other hand, refugees from areas of moderate to low endemicity, such as those fleeing from the famine-affected areas of the Sahel or the Ethiopian highlands in search of more fertile land, suffered typical malaria epidemics that affected all age groups. Refugees displaced by war in, for example, Afghanistan, Angola, Burundi, Liberia, Mozambique, Namibia, Rwanda, Somalia, Sudan, Viet Nam and Zaire have been exposed not only to the risks arising from the change in epidemiological area, but also to those derived from the continuation of involvement in the conflicts in their areas of origin, leading to a higher malaria risk among young adult males. The role of refugees in importing parasite species and strains is poorly documented, although Afghan refugees undoubtedly played a role in the spread of *P. falciparum* in Afghanistan, and refugee movements may have contributed, together with the activities of gem and gold miners, to the explosion of drug resistance on the borders of Thailand with Myanmar and Cambodia.

1.2 Emergency situations and their health consequences

In most cases it is very difficult to foresee the triggering of a mass refugee movement, but it may be assumed that all effective assistance to distressed populations has a preventive effect and that malaria control is an important part of that assistance. The monitoring of epidemic risk factors and the provision of support for emergency and epidemic preparedness in disaster-prone areas may thus help to prevent some explosive population displacements.

Disasters requiring emergency assistance and commonly leading to short- or long-term displacement of populations may be classified in two categories:

(a) *Acute disasters*, such as earthquakes, explosions, floods and cyclones, in which the main toll of death and injury occurs in the first hours or days and post-disaster morbidity is relatively low.
Although the most pressing needs are for immediate surgical and medical care and the reconstruction of basic services, populations are often deprived of appropriate sanitation facilities and sometimes need to be concentrated in camps. Social structure is generally maintained, facilitating reconstruction. In most cases, nevertheless, overcrowding of camps and the type of temporary shelters used may facilitate human/vector contact and, therefore, increase the risk of a delayed malaria outbreak following the acute episodes of diarrhoea and respiratory infections that may be the more immediate result of the period of exposure. In the case of floods and cyclones the malaria risk is further delayed, as it is the result not only of increased human/vector contact following the destruction of houses, but also of the large increase in anopheline breeding sites as the water recedes and forms pools and the disruption of organized control measures (PAHO/WHO, 1982a; Mason & Čavalić, 1965).

(b) **Chronic disasters**, such as droughts, civil disturbances and wars, often leading to long-term exodus of refugees, frequently under precarious conditions, with hazardous travel and difficult settlement; these generally cause high tolls of morbidity and death over a long period, even after concentration in refugee camps or other types of settlement.

Chronic disasters are often accompanied by the weakening or disruption of preventive health services. In malarious areas, a resurgence of malaria transmission can further aggravate the situation. In the case of wars and violent civil disturbances, the heavy toll of injuries and death often diverts health facilities to deal with them. Eventually, however, infectious diseases and malnutrition may progressively become the most serious public health problems among civilians and contribute to triggering a massive population exodus.

As mentioned above, the distinction drawn between crossing and not crossing an international border seems more and more to be relatively unimportant. Refugees and displaced populations can be considered epidemiologically similar, with regard both to the additional risks they incur as a result of their move and those they bring to the people among whom they settle. An important difference nevertheless, is that refugees are more likely to attract international attention and therefore some degree of relief, which is sometimes abundant although unfortunately often late and sometimes short-lived.

While individuals, or groups of refugees, entering developed countries may suffer discrimination and considerable mental stress and other problems of sociocultural adjustment, and may be concentrated in refugee camps, in general they are subject to quarantine measures and their
care while waiting for repatriation or final settlement follows rather standard patterns. With respect to tropical diseases, including malaria, they will represent a problem similar to that posed by international travellers, though often less difficult for the recipient population since refugees can be more easily monitored. On the other hand, the situation of the refugees themselves may be complicated by social, cultural, language and other barriers, including a lack of familiarity with tropical diseases on the part of the health services in non-endemic countries and, often, a scarcity of means for their care. Health services should address these problems through epidemiological vigilance, information and education.

On the other hand, tropical countries receiving large numbers of displaced people, whether they are the victims of political, religious or ethnic persecution, or fleeing from famine, deprivation or war, face serious epidemiological problems and their health and other services are often overwhelmed by both the number of refugees and the magnitude of their problems. Refugees often have to settle in camps providing very rudimentary shelter and sanitation. Malaria is a common risk in such situations, which are the main focus of this review.

2. TYPES OF MALARIA PROBLEMS ASSOCIATED WITH REFUGEES AND POSSIBLE OBJECTIVES OF CONTROL INTERVENTIONS

The way in which refugees become subject to the risk of malaria infection depends on:

- the whole complex of circumstances that led to their departure from their area of origin;
- the route, time and conditions of their travel;
- the physical and social environment of the area where they settle; and
- the reception and assistance, or otherwise, provided by local populations, government and external agencies.
The risk that refugees will suffer from malaria will depend on their previous immunity and the transmission potential of the areas they traverse and settle, including the infection status of other people in the same settlement:

- people leaving, moving through and settling in areas of relatively stable malaria transmission may only suffer an increased inoculation rate, with little increase in the actual incidence of disease except as a result of the debilitating effect of concomitant infections and malnutrition, malaria infection being just one additional factor contributing to their morbidity;

- in contrast, people coming from areas of marginal transmission and moving through or settling in endemic areas are likely to suffer most severely from high malaria incidence;

- non-immune people exposed to *P. falciparum* will undergo a high incidence of severe malaria which, added to other concomitant factors, may cause a very high death rate. Recent experiences include the large displacements of populations from the Sahel or the densely populated highlands of East Africa;

- populations exposed to high transmission of *P. vivax* will also suffer a serious worsening of their health status, even if *P. vivax* is not directly fatal. Moreover, transmission in most of these areas is markedly seasonal, people seldom acquire solid immunity and morbidity is highest at the time of greatest need for agricultural work.

The opportunities for intervention and its expected impact vary considerably in the different periods of risk:

(a) It is seldom possible to intervene during the pre-refugee situation, except in very limited circumstances. Interventions at this stage can be aimed at preventing the problem itself or its most serious consequences;

- the former might include efforts to assist countries in greatest need, and efforts to tackle some of the triggering factors in the area of origin; once the problem has erupted, to prevent, reduce or halt the exodus;

- examples of the latter are the planning of an orderly movement in the case of involuntary displacements of populations affected by development projects such as dams (World Bank, 1994): measures to ensure emergency
preparedness in areas prone to natural disasters (PAHO/WHO, 1982b); and, as mentioned above, appropriate planning for the return of refugees.

(b) It is even more difficult to provide assistance to refugees early during the period of migration when they are, in most cases, most vulnerable; accurate information on the situation in this period is seldom available (Toole & Waldman, 1990; Editorial, 1990a). Many refugees from areas of relatively low malaria endemicity acquire malaria infections at this time. Assistance often arrives when refugees have reached a first camp area, from which they may be directed to better organized camps, although that often requires a lengthy period of negotiation.

Although theoretically highly desirable, preparations for an expected influx of refugees tend to be the exception rather than the rule. Often, despite early concern and initial planning, actual implementation does not begin until the problem acquires sufficiently catastrophic proportions to attract international attention.

(c) Assistance, therefore, generally starts at the refugee camp.

2.1 Malaria as a problem of refugee camps

The malaria problem of a refugee camp may take one or more of the following forms:

(a) Malaria in people arriving at the camp, who may be:

- actually suffering from malarial disease, which should be diagnosed and treated on arrival for their own protection, independently of any characteristic of the camp, according to the procedures for examination on arrival laid down by the camp authority (see, for example, Somali Ministry of Health, 1983; Glass et al., 1980; Miller & Kershaw, 1993);

- asymptomatic carriers, who may require treatment for the protection of other people in the camp, when they include a large proportion of people from areas of low endemicity and the camp offers a substantial risk of transmission. In most cases individual microscopic examination will not be possible, so that detection could be replaced, at the time of registration in the camp, by treatment of any recent fever or mass treatment of people coming from or through highly endemic areas.
(b) **Malaria during residence at the camp** is to be expected in all malarious areas, and malaria episodes may continue to occur, even in the absence of transmission in the camp, either as recrudescences of inadequately treated infections, relapses, or long-incubating infections of *P. vivax*, or as a result of the exposure to infection of some group during activities outside the camp. In such situations:

- malaria diagnosis and treatment should be an integral part of the health care provided in the camp in all potentially malarious areas;

- in addition, it is necessary to determine where and when transmission occurs in the camp and surrounding areas, its intensity and what control measures can be implemented.

The risk of malaria transmission is greatly increased in all environmental situations that favour human/vector contact, and most refugee camps present these conditions. Nevertheless the nature and severity of the risk, as well as the feasibility of public health action and its possible effectiveness, vary considerably in relation to a number of factors such as population size and origin, type of shelters used, location of the camp, period of the year, meteorological characteristics of the area, soil and surface water collection, environmental modifications brought about by the establishment of the camp, agricultural activities permitted or carried out in the vicinity of the camp, social organization within the camp, relations with neighbouring populations, provision or accessibility of health services, specific antimalaria interventions conducted in the area, amount and management of external resources, and so on. It is, therefore, virtually impossible to prescribe malaria control measures of general applicability to refugee camps.

2.2 **Impact of refugee camps on the local malaria and integration problems**

There is an ingrained historical prejudice that sees in migrants, and even more in refugees, only the dangers of spreading diseases, competing for scarce resources, overwhelming the capacity of existing health and other services, creating unemployment and destroying the environment. Large influxes of refugees, prolonged stays, and agricultural programmes aimed at their becoming "self-supporting" in fragile arid environments may sometimes cause problems of erosion, desertification and
salinity, highlighting the need for control of firewood harvesting and the rationalization of the exploitation of non-renewable resources (Young, 1985).

While problems of this type have occurred, to some degree, in refugee situations, refugees have also contributed to local economic development, often suffering economic exploitation and being given unpopular, dangerous and underpaid work. Moreover, refugees often bring international assistance to an area, and this is progressively being shared as relief agencies come to recognize that refugees cannot be treated in isolation of the neighbouring populations; for example, the availability of free drugs in Rwandese camps in Burundi has attracted local people to the camp’s clinics (Ivorra Cano et al., 1994).

In most cases, the refugees are in fact the losers in the epidemiological exchange with host populations, and it is mainly their lower immunity, overcrowding and deprivation that are responsible for the magnification of disease among them. That was the case with Afghan refugees in Pakistan, where the higher frequency of malaria among the refugees led to the conclusion that they had brought a heavy load of malaria to the area; however, a study of epidemiological trends and age-specific parasite rates in the local and refugee populations showed that the refugees arrived with little malaria but, because they had a lower herd immunity, had suffered more heavily in all age groups (Suleman, 1988).

Occasionally long-term residence in refugee camps provides at least some refugees with the opportunity to acquire new skills and adapt to their new environment, which may weigh against their spontaneous repatriation. Whenever this may take place, it should be taken into account in developing health and other camp services. An analysis of the position of refugees in the social structure of production can help to explain why “some refugees become markedly better off during exile while others remain destitute” (Bascom, 1993).

Although rare, an example of successful integration with appreciation of mutual benefit on both sides was reported from the settlement of Guatemalan refugees in southern Mexico. The massive influx of Guatemalan refugees (40 000 in the early 1980s) changed the whole way of life of the local population. A true “mutual learning process” occurred in which both the refugees and the local inhabitants took advantage of the new opportunities provided by national and international assistance programmes. A study of the integration of these refugees in southern Mexico (Hernandez Castillo et al., 1993) “specifically rejects the idea of studying the impact of newcomers on an established population, but opts instead to document a dynamic process of interaction between groups
which share a Mayan culture but have until recently been citizens of two different countries. Such complete integration is clearly facilitated when local population and refugees share a common culture. Less integrated although durable, even permanent, assimilation may nevertheless also occur while cultural and social barriers are maintained.

2.3 Repatriation

Mass repatriation may often present problems similar to the original displacement. From the point of view of malaria, returning refugees may pose as serious a problem as the original exodus, or even a more serious problem, particularly when the exodus continued over many years but the return is a much more rapid and massive event.

Often repatriation is the result of long negotiations and there is a chance of organizing preventive measures, which are not possible in most mass refugee movements. When such preparations are possible, the choice of main routes and of primary and secondary camps should take into account the malaria transmission risk of the various possible sites offered.

Plans for the repatriation of large contingents of refugees are often very complex, including the design of adequate agricultural and industrial development projects (Barbero-Baconnier, 1993). Returning refugees not only pose problems of assimilation but have also been found to contribute to the spread of disease, in particular resistant strains of P. falciparum (Kondrashin & Orlov, 1989). Attracting returning refugees to development projects adds to the already complex problem of labour camps, where new mixtures of populations with different immune status against malaria will occur. Although many labourers in these camps will not necessarily be refugees, they are most likely to find themselves in refugee-like situations.

Unfortunately, even when planned in advance, it is not easy to control the movement of large contingents of people, and the organization often weakens beyond the first reception camps. The return of long-term refugees often requires the assimilation of people with different epidemiological experiences, finding destroyed homes and, therefore, likely to be exposed to increased man/vector contact during the period of reconstruction. Examples of such situations were the refugees returning to Namibia (Teklehaimanot et al., 1990) and the reoccupation and reconstruction of Kurdish villages in northern Iraq by their original inhabitants, who had been forced to gather in cities or camps during the 1980s and were allowed to return after 1991 (Najera, 1994). In both these cases there were massive malaria epidemics.
Sometimes mass repatriation, while creating upheavals as disruptive as the original exodus and requiring as much international assistance, has occasioned increased difficulties for the effective deployment of that assistance, as was dramatically illustrated by the repatriation of 150,000 Sudanese refugees in Ethiopia in 1991 (Scott-Villiers et al., 1993; Hafner, 1985). An even more dramatic example of mass repatriation was that of the Ethiopian Government army after its defeat in 1991, when the ex-soldiers were concentrated in overcrowded temporary camps of 20,000-30,000 people, and suffered serious epidemics of louse-borne typhus and malaria (Teklehaimanot, 1991).

These situations are quite different from the slow trickle of refugees who may respond to efforts at voluntary repatriation through information about the improvement of conditions in their home country and/or are pushed by the deterioration of their situation in the host country, as was the case with Yemenis returning from Saudi Arabia from the early 1980s onwards after the oil slump (Colton, 1993). From the epidemiological point of view, the problems of this type of repatriation are similar to those of any migratory flow and do not create special problems unless the volume induces the authorities to concentrate people in camps.

3. PLANNING AND IMPLEMENTATION OF MALARIA CONTROL IN REFUGEE CAMPS

Appropriate control of malaria among refugees requires the provision of care for people with malarial disease and the prevention or reduction of the risks arising from camp life, whenever preventive action is feasible. Control interventions should be based on:

- rapid assessment of the situation, using information from health authorities, WHO, health services already established in the camp, the refugees themselves regarding the dates and routes of displacement, and morbidity and epidemiological and entomological surveys, as needed;

- effective planning of feasible interventions for the management and prevention of disease, the mobilization of all available resources, and planning for the necessary training and financing;
- assessment of potential human resources among the refugees, such as physicians, nurses, technicians and other personnel previously engaged in antimalaria or other health work;

- planning of logistics and coordination of necessary inputs.

3.1 Rapid epidemiological assessment

Refugee camps are subject to considerable internal and external forces which often result in dramatic changes in their population structure, physical appearance, social relations and even location. At any time, in order to understand the epidemiological problems and plan feasible control interventions, it will be necessary to start by a rapid assessment of the current demographic and health situation and recent trends, as well as the ecological characteristics of the site.

3.1.1 The refugees

It is becoming generally recognized that epidemiological techniques for the rapid assessment of health status and needs are an essential component of any disaster relief and should be incorporated into the planning from the very beginning (Glass et al., 1980). The estimation of malaria morbidity and malaria risk should be an integral part of that assessment in any malarious or potentially malarious area.

A census is one of the first activities to be undertaken in any assessment. Generally it has already been, or is being, undertaken by the administration of the camp for its basic requirements (registration, issue of ration cards, etc.), although the census technique used may vary considerably according to available resources, size of the camp, and variations in its population:

(a) Complete enumeration by house-to-house visits, numbering of each dwelling, and drawing of sketch maps is seldom a practical proposition during the early stages, except in small camps of a few thousand people. When done with reasonable accuracy it can be extremely helpful for planning malaria control activities, particularly indoor insecticide spraying. Spraying rounds will use and update maps and censuses and, in camps where spraying is considered necessary, the spraying teams can contribute to census-taking and the preparation of the maps. Any house-to-house survey should include a fever survey and treatment or referral to existing dispensaries.
(b) In most cases a sample census is sufficient and appropriate (Stephenson & York, 1981); the sample again should be used to provide information on prevalence of fever and its age and sex distribution.

A community survey on the health situation will be needed as early as possible, to be followed up as feasible at periodic intervals, in order to evaluate nutritional status and prevalence of diseases and assess the current utilization of whatever health care services have been provided, as well as to identify particularly vulnerable groups, such as orphan children. The primary objective of the survey will be to provide an objective basis for planning specific health care interventions. In malarious areas, it should include a fever, a spleen and/or a parasitological survey. A classical malarioriometric survey, including basic parasitological, entomological and ecological variables, will provide a solid basis for planning comprehensive malaria control.

This survey can also provide information on the magnitude of refugee flow, to complement data from the camp’s reception records, particularly when there are no strong incentives to report newcomers. For example, it can indicate how many people can be considered as settled in the camp, how many are new arrivals and how many are still arriving per day/week/month.

Information on the social structure and organization of the main groups of the refugee population is important to investigate the possibility of engaging refugees to help carry out control activities or of recruiting or training health workers and health educators.

Information on sources of income of refugees, proximity to local villages, and contact with the local population is epidemiologically relevant as it may help to identify possible sources of infection.

Besides registered refugees, there may be a large number of undocumented persons in “refugee-like” circumstances - displaced populations who may be considerably more marginalized than the refugees and not have access to whatever services or benefits camp life may provide. Indeed, in long-standing camps it may be that “camp life can expose mothers to the limited acquisition of literacy skills and children who have resided in camps are more likely to be immunized and to have been enrolled in supplementary feeding programs” (Moss et al., 1992).

Whatever form of census has been taken originally, a quick sample interview or existing information on the history of the camp will make it possible to determine the place of origin of the people in the camp, the
possible presence of groups of different origins, the route and date of their displacement, and their epidemiological history. Refugees may include substantial proportions of people coming from overpopulated highlands, from cities, and sometimes from semi-desert areas after prolonged periods of drought, so that their herd immunity may be very diverse and frequently low.

Mortality estimates by age and sex and, if possible, a rough indication of main causes of death are extremely useful for prioritizing interventions, as well as for evaluating the relief programme. It may not be easy to obtain an accurate estimate of the number of deaths. The most obvious approach is to collect information on the number of burials, including the use of round-the-clock graveyard surveillance (Toole & Waldman, 1990). However, burials may occur in many different sites, and there may be resistance to counting the dead for religious reasons or because the family wants to retain the deceased person’s rights to food and services (Stephenson & York, 1981). Incentives for reporting deaths have been introduced in some camps, for example, offering free burial shrouds on condition that examination of the body is allowed and giving assurances that rations will not be decreased (Marfin et al., 1994). Even when access to hospital is available from an early stage, burial data may show a gross underutilization of this facility, justifying a tent-by-tent search for patients requiring hospital admission (Glass et al., 1980). Verbal autopsies have been used to estimate cause-specific mortality in the absence of or as a complement to hospital data.

When a large proportion of the refugees come from towns or areas of low endemicity into an area with active transmission of *P. falciparum*, or have crossed such an area during their move, malaria/fever mortality may be one of the two or three main causes of death during the first few weeks that subsequently diminishes and becomes stabilized. The drop in mortality will depend on the transmission potential in the camp as well as on the effectiveness of health care and preventive measures.

3.1.2 The site

There is seldom the opportunity to select an appropriate site for the establishment of a refugee camp. Refugees generally move in search of the nearest area where they have affinities with, or at least where they may be tolerated by, the local population and try to settle there or in any unoccupied land when and where they feel safe from the problems that triggered their exodus. The flow of refugees often surpasses the acceptance capacity of the chosen area and the host government has to redirect the refugees to other areas. In most cases settlement is an erratic and
chancy event that has been largely completed before there is an opportunity for public health considerations to come into play.

Often the initial camps can be gradually replaced by more permanent settlements, where there is the possibility of influencing the selection of the sites. Site selection may also be possible in large programmes for returning refugees, as those conceived for Namibian refugees from Angola, Afghan refugees from Pakistan, or Cambodian refugees from China.

Ideally, public health considerations for selecting the site for a human settlement call for adequate water availability, well-drained land, shelter from strong winds, and access to fertile soil and means of transport (Cuny, 1977). Unfortunately land with these characteristics is normally already occupied by local populations, so that refugees are often allocated urban wasteland or infertile, undesirable rural areas.

Choices for site location, even when offered, will most likely be very limited. Availability of sufficient water is an overriding consideration, it being a general principle that plentiful water, even if slightly dirty, is preferable to clean but limited water. General public health engineers are normally responsible for water supplies, water purification and distribution, and the location and construction of latrines, ensuring that they are at least 50 metres from the nearest water points and never above or upstream of them.

Vegetation, access to fuel, communications and the possibility of involving refugees in economic activities and achieving some form of self-sufficiency, at least in part, will also weigh heavily in the selection of a site.

In malarious or potentially malarious areas, settlements should avoid proximity to major breeding places of local vectors. In general marshy areas and flat low-lying areas that are liable to flooding should be avoided. General guidelines often recommend that preference should be given to sloping well-drained sites on fertile soil with tree cover, sheltered from strong winds (Seaman, 1981). Nevertheless, in South-East Asia the unqualified acceptance of these recommendations may lead to the choice of forested hills or foothills which may be lethally malarious, because they harbour such efficient vectors as Anopheles dirus, Anopheles fluviatilis and Anopheles minimus, which proliferate there in preference to the agricultural plains. This example illustrates the need to adapt any general recommendation to the local situation by drawing on local expertise and a knowledge of the biology of local vectors.
The epidemiological characteristics of the area need to be assessed. Basic information on the main variables determining malaria epidemiology exists for practically any area in the world, even though for some areas it is rather scarce. Such information will need to be collected from the national and local health services of both the host country and the country of origin, or from published literature and past reports available in WHO or other agencies, with particular attention to:

- *Plasmodium* species present in the area and the intensity, seasonality and limiting factors of endemicity: altitude, rainfall and aridity, forest, or savanna, etc.;

- incidence of severe malaria, frequency of clinical forms, and patients' age distribution;

- geographical and seasonal distribution of transmission by the main malaria vectors;

- characteristics of their breeding places, known biting and resting habits, anthropophily, and susceptibility to insecticides;

- evaluation and history of past control efforts;

- known risk factors for malaria outbreaks.

This information should be complemented by records from the nearest meteorological stations as well as epidemiological data from the health services serving the area. It should then be correlated with a rapid ecological survey of the specific area to determine altitude, vegetation types, agricultural practices, general drainage of the terrain, and the location of streams and surface water collections, as well as to fill gaps, if possible, in knowledge of vector distribution and habits.

3.1.3 The camp

Each camp in any given area will present its own characteristics which may enhance or decrease its potential for malaria transmission and for the implementation and success of control interventions. It will therefore be necessary to investigate in each camp the vector density, potential breeding places suitable for the local vectors, human/vector contact and the factors, such as type of shelter, proximity and orientation of the camp to main sources of vectors (forest, paddy fields, etc.), presence of domestic animals and sleeping habits of the people, that may increase this contact during the main transmission season.
A refugee camp has been described as “one of the most pathogenic environments imaginable” (Dick, 1984). In general it may be said that refugee camps tend to become less suitable for malaria transmission as surface waters become more polluted, the surroundings of the camp become more denuded of vegetation, and the camp grows larger and more overcrowded.

Most refugee camps are in a state of protracted temporariness from several points of view, particularly as in most host countries the situation of refugees is one of temporary asylum, pending repatriation or third country resettlement. That position does not encourage investment or community development, even if camps persist for many years.

The purpose of this component of relief assistance should be to control malaria while avoiding environmental degradation and improving quality of life. A number of characteristics of the camp may make the implementation of malaria control more or less readily feasible:

- regimen of the camp (open or closed), organization and administration of the camp, whether government and/or expatriate; coordinating authority; linkage to local area authorities; relationship to local populations; plans for development or resettlement of refugees;

- degree of overcrowding; features of immediate surroundings; type of vegetation;

- health services provided to the camp population and their administration; dispensaries, mobile teams and health staff; coordination and referral, and linkage with area referral services;

- participation of refugees in staffing health services or in their extension to the community, and utilization of the services;

- general services in the camp, including water supply, sanitation and drainage;

- type of shelter, and its suitability to provide protection against mosquito bites and for insecticide application (wall and roof materials, variability); the proportion of houses, tents, and improvised shelters for newcomers; turnover of refugees, construction activity in the camp, and mobility of the camp;

- economic activity, work and trade; work training programmes and education facilities; livestock;
proximity of towns, development projects, and sources of income for refugees.

There are a number of refugee settlements, not camps (e.g., in Belize, see Moss et al., 1992), which, although they contain refugees, are rather similar to the settlements of internal displaced populations because of their lack of administrative structure.

Some long-standing refugee camps and settlements, many of them over 10 years old, pose the problem of finding a balance between emergency refugee relief assistance and developmental assistance to the basic services of the host country.

As already mentioned, camps of displaced persons within their own country present the same types of problems as refugee camps but are often deprived of international support, not only because of a lack of appropriate information and the obstacles created by national authorities, but also because of the mandate of relief agencies which, in most cases, focus on refugees sensu stricto. When assistance is available, it is often modest and poorly coordinated even when, as in the Rwandan crisis of 1994, the problem was major (500 000 people, with some camps holding over 70 000) and access was relatively easy (Ivorra Cano et al., 1994).

The relocation of refugee camps, for security, political or administrative reasons, offers a second opportunity to influence site selection in favour of less malarious areas. Unfortunately technical advice is seldom sought, although relocations often require negotiations during which it may be possible to introduce a concern for local malaria risks. Understanding of this point is of special importance in areas like South-East Asia, where the malaria risk, specially the risk of *P. falciparum*, is particularly intense in the hilly forested habitats of vectors such as *A. dirus* or *A. fluviatilis*. The Khmer refugees in Thailand had to be moved frequently because of the proximity of fighting, with a tendency to move from the hilly or mountainous forested areas close to the border into more central flatter areas with sparser vegetation. Such moves achieved dramatic reductions in malaria incidence (Meek, 1988), highlighting the fact that very great differences in malaria risk may exist between sites as little as 6 km apart.

Investigating the possibility of relocation is important not only because of the desire to influence the choice of future sites, but also to determine the feasibility of proposals for investments in shelter construction or sanitation facilities aimed at anopheline control or reduction of human/vector contact.
UNHCR favours the establishment of small settlements of
5 000 to 10 000 people which may be expected to achieve self sufficiency.
One such settlement of about 8 000 people was studied in eastern Sudan.
Food supply was provided by the World Food Programme for a period of
3 months, while further food supplementation was considered for “vul-
nerable groups”. People were expected to find employment in the nearby
town, although the majority of them obtained what little income they
could from the large agricultural schemes in that part of Sudan. Diar-
rhoea and respiratory infections constituted nearly half (49%) of the total
morbidity, malaria (10%) being the fourth ranking cause after “eye dis-
ease”. The main problems were diseases of poverty resulting from
inadequate water supply, improper excreta and refuse disposal, poor nu-
trition and overcrowding. Underlying all this was a level of apparent
depression that would also have affected morbidity and mortality (Stekeletie
& Mulholland, 1982).

3.1.4 Camps as communities

Refugee camps cannot automatically be considered as communi-
ties, but rather as a collection of people from a badly damaged society
(Holt, 1981). Factors working against the creation of a community of
refugees include the dramatic experience of displacement, the stress of
the flight, the struggle for survival and the frequent dispersal between
several camps of people from a given community or village, even from
extended families (Editorial, 1990b).

The urgency of the obvious immediate needs, the language barri-
ers and other difficulties of communication, the concern with establishing
order and security, and the problems of coordination among the different
relief agencies involved, may push camp administrators to enforce a high
degree of regimentation, which if unduly prolonged will again work against
the building up of a collaborative spirit and community cohesion.

Fortunately these disrupting factors are often outweighed by the
need for security and protection among the refugees, which will soon cre-
ate some form of internal organization and leadership, whether in some
way reflecting previous political allegiances or newly created to make the
camp a reasonably peaceful working collective.

It is very important to try to understand the existence or the
growth of organization and leadership in the camp in order to be able to
channel health education appropriately and to mobilize community par-
ticipation in control measures or the designation of some form of
“community health worker”. Even more important is the establishment of effective communication and basic trust between the refugees and the camp management. A common problem has been that expatriate experts who use young school-educated people as interpreters tend to rely exclusively on them for any form of collaborative work and communication with the refugees, ending by seeing the problems of the camp only through them and giving them an authority that may not be recognized because of their youth and cultural alienation. The better the understanding of the life and problems of the camp, the more effective specialists will be in collaborating in the building of a healthy and functional society.

3.2 Methodology of control

3.2.1 Initial medical reception and assessment of potential problems

When relief assistance can be organized in advance of or during the inflow of refugees, medical screening can be set up as part of the administrative procedures on reception, before newcomers are allotted their tents or directed to their shelter.

A similar administrative allocation of refugees to camps and shelters will take place at the time of initial contact of relief assistance with a refugee population that is stranded or spontaneously camped somewhere. The possibility of setting up medical screening will depend on the degree of deprivation, the sense of urgency, the logistics support and the human and material resources.

This acute phase of emergency aid will necessarily concentrate on acute malnutrition, treatment for severe acute disease (diarrhoea, respiratory infections, malaria), measles vaccination and provision of water and food to meet basic needs.

Antimalaria activities in this phase should consist, as a minimum, of diagnosis and treatment of fever cases. Most will be only subjective fever cases, i.e., without the benefit of actual temperature measurement. Local diagnostic guidelines, if available, should be followed to identify other common fevers and treat all fevers of unknown origin with an effective antimalarial drug (based on data on susceptibility from the area where infection is suspected to have occurred).

When malaria prevalence is expected to be very high and conditions do not permit a search for other causes of fever, “mass treatment” of
all fevers, all children under five, or even the whole population could be considered as possible alternatives.

This first contact will permit the identification of people at high risk of becoming sick (possibly still in the incubation period) or of becoming infected in the camp (people coming directly from an area of very low endemicity, e.g., highlands). These people should be advised to attend the dispensary, given treatment or started on chemoprophylaxis, depending on the facilities available and the effectiveness of communication.

It should also be possible to obtain much of the information already referred to on the characteristics of the refugee population, as well as to ascertain the level of education and language ability of the refugees. Potential candidates to collaborate in the implementation of antimalaria interventions, particularly people formerly involved in malaria control or other health work, can be preselected.

3.2.2 Organization of diagnostic and treatment facilities in the camps

The provision of early diagnosis and prompt treatment to the sick constitutes the most elementary intervention in the Global Malaria Control Strategy, and is considered a basic human right. Most refugee camps, because they are well defined and relatively isolated communities, also offer the possibility of applying some form of vector control and of reducing or preventing transmission, as discussed below.

The number and type of services required for the adequate management of malarial disease will vary in relation to the prevalence of the disease and the risk of severe illness and death; prevalence will in turn depend on the effectiveness of preventive measures and the possibility of infection outside the camp. The feasibility of providing the required services will depend on the human and material resources available and the degree of community collaboration.

First-line care is usually provided by community health workers or dispensaries. In endemic areas malaria is one of the most common causes of morbidity and, because it normally responds to a simple, safe and cheap treatment, has been traditionally managed by the most peripheral health services and people themselves as self-treatment, using rather loose diagnostic criteria with very low specificity. Severe and complicated malaria, on the other hand, is a medical emergency requiring intensive care and presenting a high risk of death. It is therefore essential that peripheral services should be able to recognize signs of severity and
be backed by adequate referral services. Finally, *P. falciparum* resistant to common antimalarials requires the use of drugs that are less free from side effects and treatment that may be lengthier or more costly, so that more specific diagnosis is required, even for uncomplicated forms. The infrastructure needed will depend on the nature of the problem and risks.

The preparation of diagnostic and treatment guidelines for the training and use of peripheral health workers is indispensable for the recognition of conditions that can be handled by the first-line care services and those that require referral. Such guidelines should include the steps to be taken in initiating treatment of severe cases on their way to referral. They should be prepared in consultation with local health authorities, clinicians and consultants, and be adapted to the local pathology and the competence and resources available or potentially available in the camps. The set of modules for training courses on the management of childhood illness (WHO/CDR/95.14 A to L) provides a firm basis for developing such local guidelines.

The choice of drugs should, in principle, be based on the treatment practices or the national antimalarial drug policy of the host country. If the country has not yet formulated a specific policy, or there are reasons to believe that the policy is outdated or not adapted to the local situation, new guidelines for treatment and the selection of first- and second-line drugs will have to be developed, in accordance with the recent WHO recommendations on antimalarial drug policies (WHO, 1994), taking into consideration:

- efficacy
- simplicity of the recommended dosage regimen
- cost
- minor side-effects likely to affect compliance or absorption
- severe adverse reactions
- potentially dangerous drug interactions
- contraindications
- availability.

Table 1 lists the antimalarial drugs and doses used for the treatment of uncomplicated cases. Chloroquine is still the preferred first-line drug because of its safety and simplicity of use, but has had to be replaced by sulfadoxine/pyrimethamine in some countries owing to the spread of chloroquine resistance. In some areas of widespread multidrug resistance frequent changes have had to be made to quinine combined with tetracycline and to mefloquine and even artemisinin and its derivatives. As mentioned above, the replacement of first-line drugs with drugs that produce greater side-effects and are more complex to use would require better diagnostic targeting of the treatments.
In areas of high incidence of multiresistant *P. falciparum* malaria, the choice of treatment poses serious problems. Given the epidemiological conditions of refugee camps, there may be some justification to change the choice of first-line drugs, in search of effectiveness, before doing so for the local populations, where considerations of cost, logistics and training may argue for a delay. Both in refugee camps and among displaced populations in the Indochina peninsula, where *P. falciparum* has continuously broadened its spectrum of drug resistance, it has been necessary to change the first-line drug of choice during the last 15 years from chloroquine to sulfadoxine/pyrimethamine, on to quinine combined with tetracycline and then to mefloquine (Meek *et al.*, 1986; Meek, 1988). There are now areas with a high prevalence of mefloquine resistance (Fontanet *et al.*, 1993).

In areas with limited parasite resistance, peripheral dispensaries can continue to provide common antimalarials i.e., chloroquine or sulfadoxine/pyrimethamine as first-line treatment, provided that there is an appropriate system of referral for severe cases and treatment failures.

The use of primaquine should preferably follow the local guidelines in endemic areas. Many countries, particularly in Asia, supplement every malaria treatment with the use of primaquine as a gametocytocide, and every *P. vivax* infection with an antirelapse treatment with primaquine for 5 or 14 days. Other countries follow the advice of the WHO Scientific Group on Chemotherapy of malaria (WHO, 1990) that “it is not necessary to provide antirelapse treatment routinely to a patient living in an endemic area”, and that antirelapse treatment of *P. vivax* or gametocytocide treatment of *P. falciparum* infections with primaquine should be limited to areas free from, or with very low, transmission or to complement mass drug administration in the case of epidemics.

A system for monitoring drug susceptibility should be established to follow up the therapeutic efficacy of treatment, with the collaboration of the referral services, by carrying out simplified *in vivo* tests on parasitologically confirmed cases (WHO, 1994a).

Both the prevalence of resistant *P. falciparum* and the risk of severe disease should guide the deployment of laboratory facilities for microscopical diagnosis. In areas of high resistance the setting up of peripheral specialized “malaria clinics” providing microscopical diagnosis for fever cases makes it possible to differentiate between *P. vivax* infections to be treated with chloroquine, *P. falciparum* to be treated with mefloquine or with quinine and tetracycline in combination, *P. falciparum* with signs of severe disease which should be immediately referred to hos-
hospital, and negatives where the patient will require further study for diagnostic clues or be referred. Similar malaria clinics should be established in camps in these areas.

Maternal and child care may be provided in organized MCH clinics or limited to vaccination centres with some growth monitoring at feeding centres. Any such service should be used to educate mothers on the risk of delaying diagnosis and treatment of fevers in young children in *P. falciparum*-endemic areas. If there is any form of prenatal care it should be used to provide chemoprophylaxis, or intermittent preventive treatment, to primigravidae. If there are no such services, efforts should be made to reach them through community health workers or any other possible vehicle of health information and education; the choice of drug should be guided by the experience of local health services.

Referral services are normally provided by arranging links with health centres and hospitals of the host country in the area. Each camp should have at least a professionally staffed clinic, but establishing a camp hospital is seldom justified; during the emergency phase there are often a number of clinics provided by relief agencies or NGO's. In any case it should be ensured that diagnostic and treatment practices at all levels are adequate to deal with the local problems.

The management of severe malaria, as mentioned above, will always require referral to a properly equipped hospital. In areas of high risk, it may be necessary to strengthen the capacity of neighbouring hospitals in order to cope with the needs of the refugee population. Care should start with the ability of the providers of first-line treatment to recognize signs of severe disease, and to initiate treatment immediately. In most cases, this will require the intramuscular injection of quinine dihydrochloride (10 mg/kg of body weight), to be repeated every 4 hours for two additional doses and every 8 hours thereafter until transport to the hospital can be obtained. Management of severe symptoms should follow the established guidelines (see Gilles, 1991).
<table>
<thead>
<tr>
<th>Generic name</th>
<th>Usual content per/tablet</th>
<th>Adult dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroquine</td>
<td>100 or 150 mg (base)</td>
<td>600 mg 1st and 2nd day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 mg 3rd day</td>
</tr>
<tr>
<td>Sulfadoxine/pyrimethamine</td>
<td>500 mg + 25 mg</td>
<td>1500 mg + 75 mg (3 tablets in one dose)</td>
</tr>
<tr>
<td>Sulfalene/pyrimethamine</td>
<td>500 mg + 25 mg</td>
<td>1500 mg + 75 mg (3 tablets in one dose)</td>
</tr>
<tr>
<td>Mefloquine</td>
<td>250 mg (base)</td>
<td>- 1000 mg or 15 mg/kg of body weight (whichever is lower, in one dose) or - 1000 mg initially + 500 mg 6-8 hours later</td>
</tr>
<tr>
<td>Quinine</td>
<td>300 mg (salt)</td>
<td>10 mg/kg of body weight 3 times/day for 7 days</td>
</tr>
<tr>
<td>Quinine + tetracycline</td>
<td>300 mg (salt) + 250 mg</td>
<td>- 10 mg/kg of body weight 3 times/day for 3 or 7 days + 250 mg 4 times/day for 7 days</td>
</tr>
<tr>
<td>Halofantrine</td>
<td>250 mg (base)</td>
<td>500 mg + 500 mg 6 hours later + 500 mg 6 hours later</td>
</tr>
<tr>
<td>Artesunate</td>
<td>50 mg</td>
<td>2 mg/kg of body weight/day for 5 days, with a double dose (divided) on first day</td>
</tr>
<tr>
<td>Artemisinin</td>
<td>250 mg</td>
<td>15 mg/kg of body weight/day for 5 days, with a double dose (divided) on first day</td>
</tr>
</tbody>
</table>
(a) When resistance to mefloquine becomes a problem, its efficacy can be increased by increasing the total dose from 15 mg/kg to 25 mg/kg of body weight over two days (ter Kuile et al., 1995).

(b) The quinine course should be extended if general response to treatment over 3 days is inadequate.

(c) Use restricted to the treatment of acute *falciparum* infection in hospital or clinical settings for the treatment of multi-resistant *falciparum* infections.

(d) It is recommended that artesunate and artemisinin be used in combination with mefloquine with the following regimens:

- artesunate: 4 mg/kg of body weight once a day for 3 days,
  plus mefloquine: 15-25 mg/kg single dose on days 2 and 3

- artemisinin: 10 mg/kg of body weight once a day for 3 days,
  plus mefloquine: 15-25 mg/kg.

3.2.3 Prevention of infection during the emergency phase

It is important to achieve the maximum reduction in the impact of seriously debilitating diseases, such as malaria, on a population that is already suffering severely; levels of infection that in normal circumstances might be managed by improving diagnosis and treatment should, if at all possible, be eliminated or reduced to the lowest attainable level.

There is often a tendency to use mass chemoprophylaxis because of its effectiveness in keeping infection rates low, but it has the danger of masking continued transmission and increasing the pressure for selection of resistant parasites. Coverage with mass chemoprophylaxis can seldom be maintained as people rapidly refuse to take drugs continually.
Controlling transmission is therefore necessary in situations where any form of mass treatment (periodic mass drug distribution, mass fever treatment, chemoprophylaxis) has been introduced, in order to reduce the chance of selecting for drug resistance.

At this stage it may sometimes be possible to influence the selection of the camp site or of subsidiary camps; appropriate site selection may prevent transmission in the camp or facilitate the future implementation of source reduction measures.

Indoor insecticide spraying should be considered as a precautionary measure in the early stages of settlement, unless the absence of potential transmission is obvious. Whenever the refugee population includes people originating from areas of different endemicity, the need for that precaution increases.

Spraying of tents is, in most cases, a difficult operation owing not only to limitations of space but also to the non-absorbent nature of the surfaces to be sprayed. It should not be undertaken without professional planning to determine the appropriate alternative method of insecticide application (e.g., direct spread with a mop), dosage, required protective measures, and training of operators. If possible tents should be sprayed before being occupied, as spraying is likely to meet a high rate of refusals from the occupants afterwards.

In areas where refugees are exposed to a high risk of severe malaria, particularly if caused by highly resistant P. falciparum, it becomes even more necessary to keep transmission as low as possible, and consideration should be given to larviciding or space spraying.

The continuation of spraying or its possible replacement by alternative measures should be decided after more detailed epidemiological study. Alternatives to spraying, such as bednets or larviciding, depend on a number of variables (density of population, likelihood that breeding places are limited, environmental degradation of surroundings), which will be considered further in the following sections on preventive measures in established camps.

3.2.4 Selection of transmission control measures in established camps

In established camps, the use of preventive measures should be guided by considerations of feasibility, effectiveness and sustainability as defined in the Global Malaria Control Strategy. Refugee camps are increasingly becoming long-term settlements and their health problems
become, with a few exceptions, similar to or worse than those of the poorest communities in the world. Unfortunately, once the emergency crisis is over, international assistance tends to wane.

As indicated above, health care and preventive programmes in refugee camps require the coordinated efforts of the refugees themselves and of health planners who are sensitive to public health needs, resource limitations and uncertainties as to sustainability, as resource scarcities tend to become more frequent in long-term refugee camps (Elias et al., 1990).

In principle all antimalarial interventions can be considered for possible application, if suited to the local problem and the human and material resources available. A classification of these measures is presented in Table 2.

This table presents control interventions aimed at vector control or the reduction of human/vector contact. It does not include the use of mass chemoprophylaxis, or the expected role of primaquine in transmission control, which were discussed in section 3.2.2 above.
Table 2. Malaria control measures, by expected effect and level (individual/family or community) of protection

<table>
<thead>
<tr>
<th>Expected effect</th>
<th>For individual and family protection</th>
<th>For community protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction of human/mosquito contact</td>
<td>Bednets, repellents, protective clothing, screening of houses</td>
<td>Site selection, zooprophylaxis</td>
</tr>
<tr>
<td>Destruction of adult mosquitoes</td>
<td>Use of domestic space spraying (aerosols)</td>
<td>Residual indoor insecticides, space spraying ultra-low-volume sprays</td>
</tr>
<tr>
<td>Destruction of mosquito larvae</td>
<td>Peridomestic sanitation, intermittent drying of water containers</td>
<td>Larviciding of water surfaces, intermittent irrigation, biological control</td>
</tr>
<tr>
<td>Source reduction</td>
<td>Peridomestic sanitation, small-scale drainage</td>
<td>Environmental sanitation, provision of piped water, water management</td>
</tr>
<tr>
<td>Social participation</td>
<td>Motivation for personal and family protection</td>
<td>Health education, community participation</td>
</tr>
</tbody>
</table>

* Peridomestic sanitation will not be effective unless it forms part of collective action in which the whole community participates. Adapted from Bruce-Chwatt (1985).
3.2.4.1 Reduction of human/mosquito contact

The use of bednets, particularly pyrethroid impregnated bednets, is a very effective method of personal protection when vector activity occurs at the time that people have retired under the net. In most circumstances the effect of bednets is more evident in the protection of infants and young children, who are put to bed while adults remain exposed in the early hours of the night. Nevertheless, many of the most serious malaria vectors have their peak activity in the central hours of the night. Bednets can therefore considerably reduce human/vector contact and cause high mortality among mosquitoes attracted to man when they are used by a large proportion of the population. This can be achieved when authorities promote the use of bednets through subsidized prices, support for local production, free distribution, organization of impregnation and reimpregnation, provision of insecticides, technical support, information and public education.

People are often very eager to use impregnated bednets when they suffer from high mosquito densities (often non-malaria vectors such as Culex and Mansonia) or from bedbugs or lice; when that is the case confidence in bednets may drop if resistance develops in these pests. On the other hand, there are areas where the prevailing weather during the main transmission season - heavy nights with very high humidity and temperature without a breath of air - makes the use of bednets unbearablely suffocating to many people.

It is not always feasible to consider the use of bednets as an appropriate malaria control measure, particularly in refugee camps. The main difficulties are not only the cost and logistic problems, but also the difficulties of communication to create the participatory management of an impregnated bednet programme. In many camps the shape and size of the tents also cause difficulties for the use of a standard bednet. Bednets are more likely to be successful in well established camps, and have an important role in the protection of certain groups of non-immunes and in infirmaries or camp hospitals.

Impregnated bednets have been successfully used for malaria control in some refugee situations, such as those of Afghan refugees in northern Pakistan (Smith, 1994) and Bhutanese refugees in Nepal (Marfin et al., 1994).

Impregnation of clothes with repellents such as DEET or repellent insecticides such as pyrethroids, as well as direct application of formulations on the skin, can be effective forms of personal protection, although their collective use would pose serious logistic problems. So far
the organized use of these measures seems to have been limited to military contingents or to the personal protection of camp personnel or expatriate staff of NGOs, particularly to prevent infestation with ectoparasites such as lice.

Site selection can very seldom be considered as a feasible control measure, although the establishment of new or relocated camps may offer some opportunities, as discussed above (see section 3.1.2).

Zooprophylaxis is not easy to apply as a measure of malaria control since to be effective it requires that animals should form a real barrier between human and a zoophilic vector. When people and animals live intermixed, as was the case in many rural areas of southern Europe till the middle of this century, the attraction exerted by the cattle and pigs favoured human/vector contact, and it was only after the separation of animals from people’s houses that transmission was interrupted. Similar experience has been reported from Afghan refugee camps in Pakistan (Hewitt et al., 1994).

3.2.4.2 Measures against adult vectors

Indoor residual insecticide spraying has been the traditional transmission control measure for mass application. Its implementation has been thoroughly standardized, and most countries have the basic material and human resources to start and expand its use in a cost-effective manner. The basis of its effectiveness is that, when an effective insecticide is used against an endophilic vector, it selectively kills vectors resting indoors, which they normally do after biting because they are unable to fly long distances when fully engorged with blood.

Spraying, in order to be effective, should achieve total coverage, that is, an even application to all the interior surfaces of all the houses in a locality, at an appropriate dose and at regular intervals, as required to maintain an insecticide deposit above the minimum lethal concentration. As the vector does not normally rest long enough on the walls before biting, a sprayed house does not protect its occupants from transmission if most of the houses in the neighbourhood are not sprayed and, therefore, permit the survival of vectors that bite and become infected there. Indoor residual insecticide spraying therefore has a very high “quality and coverage threshold” to be effective. It is also often subject to the law of diminishing returns as routine services become lax, people’s cooperation wears thin, or vector resistance or avoidance requires a change to new insecticides that are often more expensive and more toxic. A summary of main characteristics of insecticides commonly used for indoor residual spraying is presented in Table 3.
Table 3. Insecticides used for residual indoor spraying

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Type&lt;sup&gt;(a)&lt;/sup&gt;</th>
<th>Dosage&lt;sup&gt;(b)&lt;/sup&gt; g/m²</th>
<th>Residual effect (months)</th>
<th>Toxicity (LD 50, mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bendiocarb</td>
<td>C</td>
<td>0.4</td>
<td>2-3</td>
<td>55</td>
</tr>
<tr>
<td>Lambda-cyhalothrin</td>
<td>PY</td>
<td>0.03</td>
<td>3-6</td>
<td>630</td>
</tr>
<tr>
<td>DDT</td>
<td>OC</td>
<td>1-2</td>
<td>6</td>
<td>113</td>
</tr>
<tr>
<td>Deltamethrin</td>
<td>PY</td>
<td>0.05</td>
<td>4-6</td>
<td>&gt; 2,900&lt;sup&gt;(c)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fenitrothion</td>
<td>OP</td>
<td>1-2</td>
<td>3-4</td>
<td>503</td>
</tr>
<tr>
<td>Lindane (gamma-BHC)</td>
<td>OC</td>
<td>0.2-0.5</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Malathion</td>
<td>OP</td>
<td>2</td>
<td>2-3</td>
<td>2,000</td>
</tr>
<tr>
<td>Permethrin</td>
<td>PY</td>
<td>0.5</td>
<td>2-3</td>
<td>&gt; 4,000&lt;sup&gt;(c)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pyrimiphos-methyl</td>
<td>OP</td>
<td>1-2</td>
<td>2-3</td>
<td>2,000</td>
</tr>
<tr>
<td>Propoxur</td>
<td>C</td>
<td>1-2</td>
<td>2-3</td>
<td>95</td>
</tr>
</tbody>
</table>

<sup>(a)</sup> C = carbamate, OP = organophosphorus compound, PY = synthetic pyrethroid, OC = organochlorine.

<sup>(b)</sup> Dosage should be adapted to local conditions and type of surfaces to be sprayed; quoted figures are expressed in terms of active ingredient.

<sup>(c)</sup> Dermal toxicity.

Adapted from: Chemical methods for the control of arthropod vectors and pests of public health importance (WHO, 1984).
Indoor spraying of residual insecticides, even if it does not have the predominant role it had in the past, is one of the most effective ways of reducing malaria transmission, and still has an important role in malaria control, particularly in the prevention and control of epidemic outbreaks.

It may be indicated in situations where its use can be clearly targeted and limited in time, and where, even if periodic applications are required, the effectiveness and quality of the spraying can be maintained. Such situations would include:

- the reduction of the transmission potential among population groups using mass chemophylaxis, as in some refugee camps or in economic development projects where refugees may be temporarily employed;

- the reduction, through regular yearly spraying, of peak transmission during seasonal epidemics, particularly when these are accompanied by a large increase in nuisance mosquitoes, thus assuring population acceptability;

- the prevention of malaria transmission, following camp relocation, renewed arrivals of refugees, or meteorological conditions indicative of high epidemic risk.

Insecticide toxicity and the hazard they may represent for spraymen and the inhabitants of sprayed houses, as well as for the environment, should be major concerns when contemplating their use. Toxicity, measured in terms of oral and dermal LD50 (in rats) for the basic compound, gives an indication of the general risk of acute poisoning, but in fact the risk depends to a large extent on the formulation being used. This is taken into account in the WHO Recommended Classification of Pesticides by Hazard (WHO/UNEP/ILO, 1994), which divides substances into highly (HH), moderately (MH), slightly (SH) and unlikely (UH) hazardous categories.

Insecticide formulations approved for indoor residual spraying have to be particularly safe as it is impossible to prevent the contact of people with sprayed surfaces and it is very difficult to ensure the use of complex protective devices by spray operators in tropical conditions.

Dose and residual effect are important considerations to determine the number of spray rounds needed to protect a population during the whole, or only the peak, of the transmission season. The dose of
application is set between a minimum and maximum determined by effectiveness and toxicity, within a range that is considerably narrower for indoor spraying than for most other applications of insecticides.

The residual effect depends on the action on the insecticide of the environment (e.g. photosensitivity of pyrethrins) or of the sprayed surfaces (e.g. absorption of water-dispersible insecticide formulations by most mud surfaces, adsorption of insecticides by some mud surfaces, inactivation of carbamates and organophosphorus compounds by alkaline surfaces). Another factor that can affect the actual residual effect obtained in a specific situation is the alteration of the sprayed surface that people may bring about by replastering, whitewashing, etc.

It is important to distinguish residual effect from biodegradability, that is the capacity of the insecticide to be inactivated by environmental or metabolic processes. Persistent insecticides that have very low biodegradability tend to accumulate through the food chain and become toxic to predator species. Insecticides such as some synthetic pyrethroids may combine a long residual effect with a relatively high biodegradability.

The standard method of application of indoor residual insecticides was devised and perfected for applying water-dispersible DDT powders on mud surfaces and thatched roofs, which were the most common sprayable surfaces in the tropics. It involves the use of pressure pumps, nozzles that deliver a flat swath, a spraying technique that ensures a pressure range, a rhythm and a distance to the wall to enable the insecticide formulation to reach the wall at a speed which, with minimum bouncing, will deposit the appropriate dosage just before run-off. Newer insecticides have been formulated to use the same equipment and method of application, even if some roof materials, such as tin or corrugated iron, and some plastic prefabricated wall materials are being used more commonly and may not retain an adequate dose with the standard method of application.

In refugee camps the use of tents made of plastic sheets and other forms of prefabricated wall materials, often with plasticized surfaces, call for substantial changes in spraying technique, as mentioned above, in order to avoid most of the insecticide being wasted through bouncing and run-off. It is not only a matter of waste, since the accumulation of insecticide on the floor may be toxic for infants, while the walls may have not retained enough insecticide. Another serious problem is that the size and shape of many tents do not permit the spray operators to keep to the nozzle-wall distance required by the technique.
A number of possible solutions to this problem are being investigated, such as preimpregnation of the plastic sheets to be used as tent materials with an appropriate dose of insecticide, or the formulation of the insecticide in paints, which would be applied and remain on the wall surfaces. In the meantime it is necessary to try locally to lower the pressure in order to reduce bouncing or to apply the insecticide suspension directly on the walls with paint rollers or mops, as available. Such forms of application reduce the choice of insecticides to those that have a wide margin between effective and toxic doses and low dermal toxicity, i.e., some of the synthetic pyrethroids.

Safety precautions should be strictly adhered to, particularly those relating to the protection of food, drinking water and cooking and eating utensils, as well as the personal protection of spray operators, who may have continuous contact with the insecticide; even if an insecticide is considered safe, it is never totally innocuous.

Problems affecting the continued effectiveness of insecticides relate mainly to the development, in vector populations, of resistance to or avoidance of the insecticide; these phenomena have also been referred to as “physiological” and “behavioural” resistance:

(a) Physiological resistance is the existence, in certain individual mosquitoes, of a capacity to survive a toxic dose of an insecticide, that capacity being genetically determined and therefore capable of being selected by insecticide pressure. Resistance may be inherited as a recessive or a more or less dominant trait; the speed with which resistance to a particular insecticide is selected will depend on the mode of inheritance, the original frequency of the resistance gene, the ability of the resistant mosquitoes to survive and reproduce, and the selection pressure, which is related to degree of isolation of the population under pressure.

Before an insecticide is chosen for malaria control, the susceptibility of the local vectors to available insecticides must be assessed. Data are often available from the same or neighbouring areas and, if possible, confirmatory tests should be carried out. Susceptibility should be monitored periodically, e.g., at the beginning and end of the transmission season or whenever there are reasons to suspect a possible change, using the WHO susceptibility kit. If possible the effectiveness of spraying should be monitored using the WHO bioassay kit, which keeps mosquitoes in contact with a sprayed surface for a fixed period of time and measures subsequent mortality. This test will indicate loss of residual effect and may be the first indication of poor quality of spraying, alterations (replastering, etc.) to the sprayed surfaces, quick inactivation of the insecticide, or developing resistance.
(b) Insecticide avoidance is a phenomenon that has acquired increasing importance as it has become more easily recognized, although it is not fully understood. Vectors avoid contact with indoor insecticide deposits mainly by resting outdoors (exophily), after biting either indoors (endophagy) or outdoors (exophagy). In some cases this is the result of natural behaviour, as with sylvatic vectors, such as A. neotomiae and A. dirus which, even if greatly attracted to bite humans invading the forest, retain their habit of resting in the dense forest vegetation. In other cases vector populations seem to have changed their resting habits after the introduction of indoor spraying. Three apparently different phenomena have been described: (i) irritability, which forces mosquitos to fly away after resting for a short time on the insecticide; (ii) repellency, which prevents mosquitos from landing on insecticide deposits; and (iii) deterrence which prevents mosquitos from entering sprayed rooms.

Besides cost, the choice of insecticides has to take into consideration effectiveness, susceptibility of the vector and acceptability to the population, the expected duration of the operations, and the expected evolution of problems of resistance and vector behaviour.

Traditionally DDT has been considered the insecticide of first choice, because of its low toxicity to humans, its relatively long residual effect, the slow development of resistance and the fact that the most common mechanism of DDT resistance does not confer cross-resistance to other insecticides. Its long persistence in the environment prescribes its use outdoors, particularly as a larvicide. Nevertheless, its use as an indoor spray has been maintained because of the low probability that sprayed surfaces, even of demolished houses, will become part of agricultural land or otherwise enter the environmental food chain.

The phenomenon of cross-resistance has commonly guided the selection of replacement insecticides when resistance to DDT has developed. Resistance to malathion is quite specific, while resistance to other organophosphorus insecticides, such as fenitrothion, and to carbamates, such as propoxur or bendiocarb, has become progressively broader in spectrum, so that a generally accepted selection sequence is DDT - malathion - other organophosphorus compounds- carbamates. This sequence also corresponds roughly to an increasing cost scale.

It should be noted that the development of resistance in malaria vectors does not depend exclusively on use of the insecticide as an indoor spray but, even more, on its use in agriculture. Thus the schedule mentioned above is only a rough guide and any particular choice must be
based on actual testing of susceptibility and information on agricultural use and recommendations.

New synthetic pyrethroids with long residual effect such as deltamethrin and lambda-cyhalothrin, which are effective at very low doses (25-50 mg/m²), and have very low toxicity, are also relatively competitive with DDT as to the cost of applications for malaria control. As their recognized cross-resistance is mainly with DDT, they have been suggested as first-choice insecticides. In fact the choice is not so simple, as at least some vectors are greatly irritated by pyrethroids, to such an extent that, although they are attracted to bite indoors, they cannot rest on a sprayed surface and leave the house before acquiring a lethal dose. This effect is particularly dangerous when the surrounding environment, as in the case of thick vegetation, offers suitable resting places for mosquitoes to survive. Such effects should be explored before embarking on large-scale spraying operations.

Space spraying of insecticides was the first method used to control malaria transmission by attacking adult mosquitoes resting indoors with pyrethrum extracts dissolved in kerosene (Park Ross, 1936). The hand "Flitgun" then used, which is still popular for domestic applications of insecticides against flying insects, produces a rather coarse spray, is not easy to calibrate, and is rather wasteful of insecticide. A very important characteristic of space sprays is the size of the droplets being dispersed, which governs the time they remain in suspension in the air and their ability to penetrate into spaces that are not fully open. Sprays are classified in accordance to their droplet size:

- **coarse sprays**, with a droplet volume median diameter (VMD) over 400 µm;
- **fine sprays**, with a VMD in the range 100-400 µm;
- **mists**, with a VMD between 50 and 100 µm; and
- **fogs or ultra-low-volume (UVL) sprays**, with a VMD below 50 µm.

There is today a wide range of equipment for the dispersal of insecticides that is capable of producing droplets of reasonably uniform size. The most common types are:

- **flitguns**, which as mentioned above are extensively used for domestic application and can be a useful complement to screening and
bednets. Such hand-carried sprayers are progressively being replaced by:

- pressurized aerosol dispensers, which produce much more uniform droplets but are more expensive and still often use fluorochlorocarbons as dispersing agent, in spite of ecological concerns and the ban on them in a number of countries;

- smoke generators in the form of mosquito coils, which are used for personal protection;

- thermal foggers and mistblowers, which are either portable, like Swingfog, or aircraft- or vehicle-mounted large-capacity machines; used extensively for nuisance mosquito control, and occasionally for the control of malaria outbreaks, they produce a very perceptible insecticide cloud, which sometimes has more of a public relations than an epidemiological impact; they are progressively being replaced by:

- ultra-low-volume (ULV) sprayers, which are available as portable knapsack blowers, or aircraft- or vehicle-mounted machines; they produce true aerosols and are widely used for mosquito control in urban areas, as well as for epidemic control of mosquito-borne arboviruses, particularly dengue and the encephalitides; the effectiveness of aircraft- or land-vehicle-mounted ULV applications, similar to those used for dengue epidemic control, has not been clearly demonstrated for the control of malaria epidemics; more success has been achieved by the use of knapsack blowers on peridomestic vegetation for the protection of refugee camps and other settlements in jungle areas or the periodic (weekly or fortnightly) indoor ULV application of pyrethroids for the control of multiresistant vectors; the more spectacular effect of such applications on flies and household pests often results in community acceptance and demand.

In general, there are very few indications for space spraying in malaria control. It is expensive and is much less effective than for Aedes- or even Culex-transmitted diseases, Aedes, and Culex when disturbed, may become active during the day and are generally fully active at dusk, while the most efficient malaria vectors become active in the middle of the night, and their populations are more dispersed in their daytime resting places, even those attacking compact human settlements such as refugee camps; thus they are difficult to reach by fogging done while there is some daylight. Nevertheless, malathion applied indoors and outdoors with ULV knapsack sprayers showed reasonable effectiveness against Anopheles and Aedes in Nigeria (Bown et al., 1981).

Refugee camps often have a high population density, domestic drinking-water has to be stored in containers, their immediate vicinity
has been stripped of vegetation and therefore offers few resting places to anophelines, and surface water collections may be contaminated. Under such conditions *Aedes* may breed profusely in domestic containers and *Culex* in polluted outdoor water, so that the use of space sprays against these pests may therefore be justified.

Fogging was used in Khmer camps in Thailand as part of a comprehensive effort to control malaria transmission in an area of high prevalence of multiresistant *P. falciparum* malaria and exophilic vectors (Meek, 1988).

### 3.2.4.3 Measures aimed at the destruction of mosquito larvae

The impact on malaria transmission of destroying mosquito larvae depends on the bionomics of the particular vector species. The elimination of peri-domestic mosquito breeding places, including the protection of domestic water containers, and the maintenance of clean surroundings have a general health interest. However, the specific measures that affect malaria transmission may vary from area to area. For example, because *A. stephensi* in the Persian Gulf and the Indian subcontinent breeds in clean water containers indoors, they need to be carefully protected or periodically drained, while protection from contact with some sylvatic vectors will require a wide vegetation-free strip around the houses. It should be borne in mind that, as an antimalarial measure, peri-domestic sanitation requires complete coverage in order to be effective; a single remaining active breeding place may suffice to maintain a substantial focus of transmission. For this reason the collective mobilization of individual action for peri-domestic sanitation should be based on a precise understanding of vector bionomics and will require some form of inspection and sanctioning of non-compliers, as instituted in some urban areas, e.g., the legally enforced screening of water tanks in Bombay, India (Covell, 1928).

Larvicidding, as an antimalaria measure, has limited applicability as it affects only vector density and requires a very high coverage for effectiveness, without the advantages of sustainability and socioeconomic benefits that sanitation may have. It is therefore indicated only for densely populated areas with relatively few breeding places - e.g., some refugee camps in areas with low rainfall - if the required very high treatment coverage can be achieved. The main larvicides used in malaria control are as follows:

(a) Larvicidal oils, crude oil, diesel oil, petrol, kerosene or proprietary formulations such as Malariol, containing a spreading agent, are the oldest
larvicides used. As their main action is achieved by suffocating the larvae, distribution covering the entire water surface is required, but this can be interrupted by protruding vegetation and wind. Volatile oils have been shown to be lethal not by suffocation but by water penetrating the trachea. Lead-free aviation petrol, which evaporates in a short time without leaving a residue, has been used for the control of well-breeding A. stephensi in some urban areas in India. Modern larvicides include a number of monolayers and other surface-active compounds, but results against anophelines have been in general disappointing (Gratz & Pal, 1988).

(b) Synthetic residual insecticides were used as larvicides to complement indoor residual spraying until it was recognized that such applications were responsible for rapid selection of insecticide resistance and might cause environmental damage. The use of chlorinated hydrocarbons as larvicides, and that of DDT for any outdoor use, has been proscribed (WHO, 1971). Today the larvicides most used for mosquito control are fenthion for polluted waters and temephos for clean waters that may be used for animal or human consumption.

(c) Polystyrene beads are used mainly to control mosquito breeding by covering all the water surface of abandoned wells, cesspools and other confined breeding sites.

(d) Larvicides of biological origin include juvenile hormones such as methoprene, other growth regulators such as diflubenzuron which inhibits chitin formation, and toxins of bacterial origin such as formulations of Bacillus thuringiensis, none of which have yet found practical use in malaria control, despite promising results in limited trials of slow-release formulations.

Biological control includes the use of mosquito pathogens and predators. Although there are a number of known mosquito pathogens (viruses, bacteria, protozoa, fungi and nematodes), few have been used for mosquito control and none have reached operational use for malaria control. In contrast, the use of larvivorous fish has a long history in malaria control; a number of genera and species have been involved, among which Gambusia affinis, G. holbrooki and Lebistes reticulatus are by far the most widely used. Managing larvivorous fish is not a simple matter, nor is control automatically maintained; like most biological regulators, the predators will reach a state of equilibrium that may not be sufficient for transmission control when dealing with an efficient vector. It will therefore be necessary to upset that equilibrium by seeding with additional fish important breeding places.
3.2.4.4 Source reduction

Environmental management constitutes the most effective and sustainable measure for the protection of dense human settlements and urban areas. The effectiveness of environmental management in reducing malaria transmission was recognized long before its biological basis was understood. The implementation of community-wide environmental management requires the mobilization and commitment of substantial community resources, not only to promote, support and coordinate individual action, but, in most situations, to undertake engineering works. It is therefore essential that such actions be carefully planned, based on an appropriate knowledge of the local epidemiology and the biornomics of the vectors it is intended to control. Professional entomological and engineering competence must be continuously available for the planning and execution of sanitation projects, which have to be evaluated from the viewpoint not only of malaria control, but also of their general health and socioeconomic impact. Many of the refugee camps in the tropics, where sanitation may be introduced and where pollution may eventually eliminate breeding in surface waters, are changing so rapidly that drastic changes in the epidemiological situation may have occurred between the time plans are drawn and the time they are executed.

Breeding places of malaria vectors may vary, according to the species - or even the karyotype - concerned, from permanent to transient bodies of water, from fresh to brackish water, from standing water to flowing canals and open streams, from sites fully exposed to the sun to deep shade, from shallow pools to deep wells, from clean drinking-water to water highly polluted with organic matter, from large open marshes to the tiny pools of water that collect between the leaves of bromeliads, in plant axils, in tree holes, in rock or crab holes, in cattle footprints or in discarded containers. Therefore the reduction of vector breeding has to be tailored to the local species, and may be achieved by reducing the number of suitable places or by modifying some of their essential characteristics. Environmental management consists of the selection of appropriate measures as discussed below.

Drainage, filling and prevention of unnecessary surface water collections are among the most traditional antimosquito measures, although they have mainly been undertaken in response to economic incentives. Unfortunately, drainage of unwanted water seldom presents as much economic interest as the introduction of water for irrigation, so that in a large proportion of major irrigation projects appropriate drainage systems have either not been constructed or are not properly maintained. Similarly, leakage from irrigation canals, overflows and misuse of irrigation water.
often produce extensive breeding places and, eventually, waterlogging. This is not only a major cause of malaria but also of land degradation, leading to salinization and eventual desertification.

Other forms of source reduction, such as artificial shading or clearing of river or canal banks, changes in plant-water-air interface, changes in salinity, the desalinization of coastal swamps, or increases in the organic content of breeding sites, have very limited local applicability in refugee camps.

3.2.4.5 Community participation

The Global Malaria Control Strategy places the greatest emphasis on the building of local capabilities to understand and solve problems, more than in the massive use of drugs or insecticides, in the hope of reaching every house and every patient. The Strategy promotes the establishment of all possible intersectoral linkages, as well as community involvement. The main aim of public information and education should be to improve peripheral management of fevers, particularly in young children in highly endemic areas, to improve the utilization of health care facilities, and to obtain the active participation of individuals and communities instead of the passive acceptance of antimalarial drugs or spraying. The school should play a key role as an instrument of education not just for children; it has been found in many camps that refugees may agree very eagerly to attend school, if offered the opportunity.

This participatory antimalaria strategy gives a prominent role to the development of malaria-safe habits, including the use of personal protection measures and chemoprophylaxis during pregnancy. It appears obvious that the development of such habits cannot be a function of the school alone; women can be essential partners, if their social status permits their incorporation into the education process.

3.2.5 Early detection and containment, or prevention of epidemics

Ideally, malaria epidemics should be predicted and prevented, not detected and controlled. Forecasting may be possible if based on a dynamic information system capable of identifying high-risk periods, areas and populations, and of designing and implementing appropriate control measures. As the most relevant information is of an ecological, meteorological, social or economic nature, it is necessary to establish linkages and obtain data on these variables as well as on the plans and state of implementation of economic development projects, which may use the cheap labour force provided by refugees.
Most frequently, nevertheless, epidemics are not recognized until they are well advanced in their evolution, when the epidemic is often already subsiding or has resulted in a well established higher level of endemicity. Under these circumstances not much benefit may be expected from the mobilization of extraordinary control measures, particularly if they are not ready for immediate implementation.

In general, control measures to counter a detected epidemic should consist of strengthening disease management; if the epidemic is detected at the beginning of a potentially long transmission season, residual insecticide spraying should be considered, particularly if it has been included in the emergency preparedness plan and the required resources are immediately available. Unfortunately in most cases spraying is recommended as the main response, without the capacity to apply it at the right time, so that it is done after the end of transmission and totally wasted. If preventive measures cannot be mobilized in time, consideration should be given to mass fever treatment or even mass drug administration.

Residual insecticide spraying should be supplemented by strengthening the epidemiological information system and diagnostic and treatment facilities, public information and education, the promotion and support of personal protection measures, and the mobilization of intersectoral collaboration.

In responding to epidemic outbreaks, the following principal categories should be distinguished:

(a) epidemics resulting from an abnormal increase in disease transmission, in non-endemic areas or areas of low endemicity, owing to short-lived increases in vector density as a result of high rainfall or floods, or in vector survival following prolonged periods of favourable temperature and humidity. It should be noted that epidemics of this type are the result of intensive but short - often very short - periods of transmission, so that control measures mobilized after the epidemic has been detected are generally applied when the epidemic is subsiding and are therefore quite ineffective. They can nevertheless be prevented if predicted, which is often possible since these meteorological abnormalities generally follow a quasi-regular periodicity (5 to 10 years, in some areas longer).

A timely preventive response can be made if relevant meteorological variables are monitored and epidemic preparedness has been ensured. Analysis of historical data from the area make it possible to identify the main determinants of epidemic risk and estimate the time between the meteorological episode and the peak of transmission, which
is the time available for the implementation of preventive measures. It may be assumed that floods will produce the geographical spread and high densities of pool-breeding vectors after the decline of the water levels, allowing as much as one month or more to implement vector control. Following prolonged and heavy rain and a consequent increase in rainpool-breeding vectors, the period may be only a few weeks. In the case of increased vector survival, there may be no time for vector control and the only control measure practicable may be to ensure extra availability of drugs or to institute chemoprophylaxis, the choice depending on the expected magnitude of the problem.

(b) Epidemics reflecting a new high endemic potential as a result of lasting modifications of the environment, such as agricultural expansion in potentially malarious but previously uncolonized areas. This type of progression has been documented for following the colonization of the Amani highlands in the United Republic of Tanzania (Matola et al., 1987), and could also occur when agricultural activities of refugees around camps in undeveloped areas are supported. It is seldom realistic to expect that such populations can be maintained permanently free of malaria transmission; ultimately the area will acquire an endemic equilibrium and malaria control will consist of disease management. The role of control during the epidemic period should be to install the necessary facilities for diagnosis and treatment immediately and to smooth the transition to endemcity by introducing vector control or mass fever treatment during seasonal peaks of transmission.

(c) Epidemic outbreaks resulting from increased arrival of non-immunes, for example a new flood of refugees. This type is similar to epidemics at development projects attracting labour forces. A choice has to be made whether to protect the newcomers from infection, through vector control or chemoprophylaxis, or to allow the development of immunity backed by epidemiological surveillance and prompt treatment of disease. The choice should be made in the light of the expected length of stay of the population at risk as well as available resources and the sustainability of control efforts.

(d) Epidemic resurgence of malaria transmission in endemic areas where vector control or chemoprophylaxis has succeeded in reducing malaria incidence to levels well below the ecological potential of the area for a number of years, but suddenly control measures have been discontinued, owing to the interruption of financial support or the development of resistance through unsustainable vector control measures or chemoprophylaxis. This type of epidemic is an indication of the unsustainability of the original control strategy. In most cases, by the time the situation is recognized, the disease has spread throughout the
camp and the only feasible control is the strengthening of disease management facilities and the exploration of feasible transmission control measures, while avoiding the reintroduction of the previous approach to vector control. The epidemic situation can be prevented if the withdrawal of control measures is planned in advance and carried out smoothly, for example by passing from continuous to seasonal control before total withdrawal, if this is necessary, and by the strengthening of treatment facilities.

The feasibility of prevention or control of epidemics depends, therefore, on the capacity to monitor risk factors within the camps, such as new arrivals of non-immune population groups or the relocation of certain camps, and to exchange information with surrounding localities in order to monitor factors that may affect the whole area.

Whenever epidemic risk is linked to cyclical meteorological phenomena, specialized services should draw up an emergency plan and promote emergency preparedness among all partners in the programme.

3.2.6 Establishment of an appropriate epidemiological information system

There can be no doubt that an information system is vital for the proper planning and implementation of any preventive intervention, particularly as, in the case of malaria control in refugee camps, it is expected to involve a variety of collaborating partners.

Epidemiological information should be based on accurate reporting of the activities of the various partners involved. The usefulness of such reporting should be clearly perceived by the services concerned; it should never become a burden and provoke non-compliance or inaccurate reports.

The information system should provide for the surveillance of high-risk groups, such as unaccompanied children, single parent families, ethnic minorities, and unregistered and transient refugees, that may otherwise become the deprived among the deprived (Dick, 1984).

The epidemiological information system required for the surveillance of malaria and other infectious diseases should be developed from the mechanisms set up for the initial evaluation of the epidemiological situation in the camp (see section 3.1 above) and should allow for the continued monitoring of morbidity and mortality, while placing a minimal burden on health workers (Marfin et al., 1994).
It is, nevertheless, often difficult to establish the degree of collaboration needed to be able to collect that information, and even more difficult to establish and maintain the capacity to consolidate, analyse and use epidemiological information.

Minimum information requirements are different for different purposes and will vary from place to place. In all areas, in order to support efforts to improve disease management, it will be necessary to obtain certain data:

(a) Data on mortality and morbidity are required to prioritize, select, plan, monitor and evaluate specific control interventions. In order to involve lay sources of information it will be essential to provide clear clinical case definitions for major causes of morbidity. For example, in Nepal the following conditions were selected: bloody diarrhoea, suspected cholera, other diarrhoea, moderate to severe acute respiratory infections, malaria, measles, suspected hepatitis, suspected encephalitis, injury, and other/unknown (CDC, 1993). In other areas, particularly those with a high incidence of *P. falciparum*, malaria may be equated with fever of unknown origin. The monitoring of malaria morbidity may require somewhat different definitions for epidemiological and logistic purposes; while the selection and targeting of different measures should be based on an estimate of the population groups and numbers of people affected, the planning of drug supplies and deployment of facilities require the number of disease episodes that should receive antimalarial treatment according to current guidelines.

(b) Data on changes in parasite susceptibility are essential to maintain effective treatment.

In areas where vector control is contemplated, it will be necessary to obtain the following additional information on:

(a) The identification of vector species and information on resting and biting habits will be needed in order to plan vector control.

(b) Data on the susceptibility of the vector(s) to insecticides, estimated total surfaces to be sprayed in square metres and number of shelters, will be necessary in order to estimate requirements of insecticides, equipment and personnel, including training, and to calculate the time needed to complete all the required preparations.

The planning of other control measures will require more precise information on their targets as well as the availability of human resources
or the possibility of recruiting and training them, in which case plans for training and related logistic requirements should be drawn up.

The main sources of information should ideally be all health care providers, and this may require the monitoring of a number of epidemiological variables at the different levels of care functioning in the camp, instead of considering all patients as "malaria cases". Thus reports should be collected on "fever treated with antimalarials" from community health workers or other forms of lay health posts, "clinically diagnosed malaria" at dispensaries staffed by trained nurses (government or other agencies, NGOs), "referred severe cases" and "referred treatment failures" from health centres and hospitals. It is highly desirable to record "parasite positivity among referred severe cases" and "among treatment failures" received at treating hospitals or health centres, where microscopical examination may be possible. It is very important to recognize that the case definitions used are different for data coming from all these different sources and that, although all should be considered in making consolidated estimates of the burden of malaria, data responding to different definitions should remain separate and be reported and consolidated as different entities.

In comparing data from refugee camps with those from the existing antimalaria programme or health services in the neighbouring areas of the host country, it will be necessary to determine the relationship between the different case definitions and reported data. If necessary an appropriate survey should be carried out, in order to obtain data on:

- the quantitative distribution of the malaria problem in the different camps and in surrounding areas, particularly those in which refugees engage in economic activities such as seasonal agricultural work;
- the severity of malaria, frequency of specific severe clinical forms and complications, and mortality;
- trends, which will entail the determination of relationships between time series of comparable variables; they will also require the collection of earlier information from general health services, which may not always have been analysed by malaria programmes;
- vigilance with regard to specific problems, particularly drug susceptibility and, in some cases, insecticide resistance or avoidance;
- meteorological indicators of epidemic risk;
- socioeconomic indicators of epidemic risk, such as new colonization areas, mining, etc.;
people's attitudes towards the refugees, as well as those of the services towards the exchange of information.

It is obvious that a fully satisfactory level of information can very seldom be regularly obtained. In most cases, as camps become better established and collaboration from the refugees is more active, information systems become more functional and better adapted to the needs for planning and evaluation. Nevertheless, as already mentioned, the evolution of any camp is subject to rather disruptive crises, such as the withdrawal of external support once it is considered that the emergency situation has passed, a decision to move the camp, which frequently is unpredictable, or a decision to encourage repatriation, which sometimes entails the progressive withdrawal of assistance even if the camp still continues for a long time.

3.3 Logistics

As mentioned above, the establishment of refugee camps creates a sudden need to organize health care and a number of specific interventions, including malaria control, completely from scratch, for large population groups. In order to make these interventions possible it will be always necessary to organize massive logistics support and to ensure adequate security, although they may not always be easily achieved.

In particular, the adequate management of initial interventions, screening, and allocation of refugees to different camps often makes the provision of shelter, food and water such an overriding priority that it tends to eclipse everything else.

Nevertheless, as also mentioned, the benefits of early epidemiological assessment are now recognized and expert advice on the planning of appropriate interventions is being sought in the first few days of the emergency. The need to plan requirements carefully and to ensure the necessary logistics support to obtain them in time cannot be overstressed. Refugee camps are frequently located in areas with difficult access, and the arrival and distribution of supplies are often slow, complicated and uncertain.

The possibility of obtaining the required resources locally, or from the most accessible alternative sources, must therefore be explored exhaustively.
Coordination should be established between the different providers of supplies to avoid confusion in the use of different products or different formulations of the same product, for example the provision of chloroquine tablets of 100 mg and of 150 mg base content. The programme is seldom in a position to reject any donation, but they should be careful to ensure a separate distribution and, if supplies have to be changed in a particular camp, to provide clear warning of the dose adjustments to be made.

4. COORDINATION

History indicates that international relief action has not been very effective in preventing major health problems, or even in providing timely relief (UNHCR, 1993). Refugee situations have often been in the hands of well-intentioned, but short-term and poorly prepared personnel engaged in overlapping and loosely coordinated efforts (Elias et al., 1990). The problems may be further compounded by pressures for high visibility aid and the capricious nature of the mass media (Dick, 1984, 1985).

The response of the international community to humanitarian emergencies is provided by a network of international and national organizations which often function independently of each other, if not in actual competition. During the last 10-15 years there has been a continuous enhancement of the role played by NGOs and private voluntary organizations as channels for the provision of relief assistance by donors, to a large extent replacing national governments and United Nations agencies, which are considered too limited in their capacity for direct action; UNICEF remains an important channel for such assistance, since its mandate allows the direct provision of assistance without the prior permission of the government, or in areas with governments not recognized by the United Nations General Assembly. Since 1991, after the end of the Cold War period, it appears that support for humanitarian assistance has increased rapidly, in contrast to the general stagnation of development assistance. At the same time, there have been serious efforts to introduce mechanisms and organizational changes aimed at improving coordination among donor organizations and the United Nations agencies, and the effectiveness of their response (Borton, 1993).
UNHCR, which coordinates United Nations action in refugee assistance, has been influenced by the changes in orientation of funding mentioned above, and it now channels most of its activities through NGOs. During the last few years WHO has considerably strengthened its Emergency and Humanitarian Action programme, which has been provided with the capacity for direct intervention in emergency situations.

Throughout the existence of refugee camps in any area, coordination must be established between the health services, their information systems, and any specific preventive programme such as malaria control, with similar services for the local population, as already been stressed above. It is particularly important in long-standing refugee camps for relief assistance to be coordinated with development collaboration with the host country (Steketee & Mulholland, 1982).

Technical coordination is essential, particularly when there are a large number of agencies providing relief assistance in the same area, in order to standardize guidelines, training and preventive activities, and if possible to permit collaboration in the effective use of resources (Clugston et al., 1986).
REFERENCES


