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**PREVENTION
OF THE RE-INTRODUCTION
OF MALARIA**

Report of a WHO Meeting

WORLD HEALTH ORGANIZATION

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**WHO MEETING ON THE PREVENTION
OF THE RE-INTRODUCTION OF MALARIA**

Washington, D.C., 14-18 November 1966

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PREVENTION OF THE RE-INTRODUCTION OF MALARIA

Report of a WHO Meeting

A WHO Meeting on the Prevention of the Re-introduction of Malaria was held in Washington, D.C. at the headquarters of the Pan American Sanitary Bureau, which acts as the WHO Regional Office for the Americas, on 14-18 November 1966. Dr D. Sencer was elected Chairman, Professor N. N. Dukhanina Vice-Chairman, and Professor R. H. Black Rapporteur; Dr D. F. Clyde, Dr G. García Martín, Dr Z. G. Panos, Dr C. Díaz del Pinal, Dr T.-Y. Lee, Dr C. C. Saraga, and Mr D. Schliessmann were elected Co-Rapporteurs. Dr A. Horwitz, Director of PASB and WHO Regional Director for the Americas, opened the meeting and welcomed the participants.

INTRODUCTION

The substantial progress that has been achieved in the eradication of malaria is reflected in the title of this report. This progress should not be jeopardized by the re-introduction of malaria from less fortunate countries that still suffer from it. Among the main problems that must be solved to ensure adequate protection against re-establishment of malaria are (1) the lack of completely reliable laboratory methods for the detection of the disease; (2) the inadequate availability of international information on the status of malaria in different areas (and the lack of such information at all levels of national agencies responsible for the checking of immigrants, who constitute a special risk); (3) the lack of co-operative action by malarious countries, which often do not provide relevant information to persons leaving their territory; (4) the risk of importation of strains of *Plasmodium falciparum* resistant to 4-aminoquinolines into receptive countries; (5) the unchecked passage of people across borders and through seaports; and (6) the need for greater collaboration between all countries and agencies interested in traffic and transport problems.

1. EXPERIENCE IN THE USE OF PREVENTIVE MEASURES

A number of countries reported their experience in the application of preventive measures, and from these reports certain general facts emerged.

There is a considerable difference between countries that have natural boundaries — e.g., islands — and those that adjoin other countries where malaria exists (or those that have eradicated malaria from only part of their territory). However, even countries that have natural boundaries are subject to unchecked entry and thus do not have as complete control over the entry of infected persons as might be expected.

Transmission of malaria may be re-established by the entry of infected persons, the importation of infected anopheline mosquitos, or parasite carriers not found during the malaria eradication campaign.

Possibly infected persons entering a country may be grouped in three classes :

(1) Nationals returning from residence in malarious areas. Some countries advise such persons, prior to their departure for malarious areas, on methods of protection against the disease. Upon their return they may be screened at the port of entry and, if necessary, visited at home and given radical treatment. Countries with overseas malarious territories may examine blood films from all persons before their departure from the overseas territory to the mainland, and administer radical treatment to all those found to be infected.

(2) Arriving foreigners and international travellers in transit. It appears that at the port of entry such persons can only be advised, although they can sometimes be followed up. Some countries use malaria information cards, as suggested in the tenth report of the WHO Expert Committee on Malaria.¹

(3) Various groups who are more dangerous than others as potential importers of malaria. Such groups may be subjected to special preventive measures under the International Sanitary Regulations. Servicemen returning from overseas military duty may pose a special threat; it is, therefore, important to have complete co-ordination between the military and the civilian health services.

It was noted that in many countries co-operation between quarantine and immigration services is useful for acquiring information on the entry of possibly infected sources. Customs and police reports of illegal entry are another source of information. Nomads, refugees, and immigrant

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1964, 272, 23, 51.

workers from malarious countries are a major source of imported cases in some countries. Immigrant workers from malarious countries may not live at the addresses they declare at ports of entry; they move around looking for work, aggravating the problems of surveillance. In some areas, countries with contiguous borders hold periodic meetings to discuss the problem of imported malaria. Such meetings have, for example, arranged for priority to be given to phased malaria eradication programmes in border areas. This is not always the case, however; some countries, where malaria transmission has long been interrupted in certain areas, must maintain such areas under protective attack measures because of the steady importation of large numbers of cases from bordering areas of another country where malaria has persisted at a fairly high level.

The screening of persons arriving from malarious countries has produced positive results in some countries, but in general it can be stated that the main method of detecting imported cases has been active case detection; vigilance based on multi-purpose home-visiting has been necessary in some areas. Some countries in which malaria is seasonal increase their preventive activities seasonally.

There was general scepticism, among the participants in the meeting, concerning certificates of disinsection signed by aircraft captains, despite the fact that the International Sanitary Regulations emphasize their importance. A number of countries reported that they spray aircraft after arrival despite some inconveniences to passengers.

In some situations, it has been difficult to establish whether resumption of transmission has been the result of spreading from an imported case or from a persisting, previously unrecognized infection. This difficulty is particularly encountered with of quartan malaria.

Malaria is a notifiable disease in most countries. In some countries, however, it is not notifiable, for a number of reasons. The participants in the meeting agreed that malaria should be notifiable even if the system of notification used has shortcomings.

Confirmed cases of malaria, it was reported, are given radical treatment in all countries, and investigations are made in the surrounding population as indicated by the history of each case. These investigations include examination of blood-films from an appropriate number of people (central checking of such films was reported by a number of countries) and entomological study of the vector in the area. Appropriate precautionary measures are taken where necessary.

In addition to the detection and treatment of imported cases, steps taken to prevent the re-introduction of malaria include local measures against mosquitos in general, and anti-anopheline measures in areas of high receptivity; such measures are both antilarval and imagicidal (when indicated). A number of these areas are seaports or are popular with tourists, and are thus subject to the threat of repeated importation of

malaria. Areas where water is impounded and those where labour forces are gathered may also be highly receptive.

One country reported giving suppressive and sporonticidal anti-malaria drugs to immigrants arriving from malarious countries, with the aim of rendering them non-infective for about one month. By this time they have usually settled down at a stable address and can be followed up by the peripheral health service.

Co-operation in the identification of malaria cases on the part of general medical services has varied from country to country. Laboratories are adequate in number, but many instances of failure to diagnose or delay in diagnosing malaria have been noted; the responsibility is shared between the medical staff and the laboratory services. Adequate training of medical personnel and retention, within the health service of a country, of personnel skilled in all aspects of malaria control are most important.

Apart from the public health implications of imported malaria, it is essential to remember that delay in diagnosis frequently results in severe illness and even in death. For this reason also, adequate briefing of travellers is most important.

Details of imported cases of malaria were reported as follows :

Hungary: During the last 5 years 26 imported cases were found, all but one having come from Africa.

Israel: During the period 1961-65 there were 133 imported cases, of which 73 were detected by passive and 60 by active case detection. Of the total, 57% were foreign visitors. Arranged according to causative organism, the numbers of cases were *P. vivax*, 68; *P. falciparum*, 57; *P. malariae*, 5; and mixed, 3. Most of the cases came from Africa; others were from Asia, Europe, and Oceania.

Spain: In 1965 there were 19 imported cases, 12 of which were infections with *P. vivax*. All the infections were acquired in Africa.

Taiwan: During 1959-66 there were 622 imported cases from 22 different countries in Asia and Africa; 90% of the infections were in refugees. Of the total, 502 cases were detected by screening on arrival, 78 by follow-up examinations, 37 by public health clinics, and 5 by voluntary collaboration. All four species of parasite were found, but *P. vivax* accounted for 78% of the infections.

USSR: During 1963-65 there were 535 imported cases from 36 different countries. All four species of parasite were found, but nearly half were *P. falciparum*.

Venezuela: During 1965, blood films were taken from 5.4% of the population of 5.86 million in the maintenance phase of malaria eradica-

tion. Of the 1597 cases of malaria detected, 1076 were imported from other parts of the country, 180 were imported from abroad, 339 were introduced, 1 was a relapse, and 1 was induced.

2. SCREENING OF IMMIGRANTS OTHER THAN INTERNATIONAL TRAVELLERS

2.1 Information from national or international sources

As malaria is not a quarantinable disease, protection against its re-introduction cannot be based on quarantine measures. The prevention of re-introduction of malaria into areas from which it has been eradicated was dealt with in the tenth report of the WHO Expert Committee on Malaria, which noted that although "it is necessary to protect the people who have been freed from malaria and to preserve the investment of money and effort that has been made by preventing the reintroduction of malaria . . . it is desirable that the preventive measures introduced should not unduly impede the free movement of people".¹ The recommendations of the Committee on International Quarantine relating to protection against malaria, which were subsequently adopted by the World Health Assembly, state that "Persons on international journeys should not be subjected to any special sanitary measures",² but article 103 of the International Sanitary Regulations states that "Migrants, seasonal workers or persons taking part in periodic mass congregations, and any ship, aircraft, train, or road vehicle carrying them, may be subjected to additional sanitary measures conforming with the laws and regulations of each State concerned, and with any agreement concluded between any such States".

It is obvious, therefore, that regular information from international or national sources is of paramount importance for tracing persons who, coming from areas where malaria is still endemic, constitute a threat to countries they enter, if these are receptive to malaria, or who may themselves be in danger of suffering the severe consequences of the disease.

The purpose of information from international sources is to indicate areas of the world where there is risk of contracting malaria during either a period of residence or a brief stop-over; the purpose of national information is to indicate areas within a country that are receptive to malaria. Within each country, relevant international information should be given to all interested persons, and information should be obtained and disseminated (preferably in advance) relating to the arrival of groups who should be screened for malaria infection and, if necessary, followed up at their destinations.

¹ *Wld Hlth Org. techn. Rep Ser.*, 1964, **272**, 13.

² *Off. Rec. Wld Hlth Org.*, 1958, **87**, 413.

2.1.1 *International information*

International information is given to all governments by means of the *Weekly Epidemiological Record*, published by WHO. Twice each year the *Record* gives detailed epidemiological information on the status of malaria eradication in the world. This information includes :

- (a) brief comments on the data published;
- (b) a map, published annually, indicating areas that have never been or are no longer malarious, areas in the consolidation phase, and areas where malaria transmission occurs or might occur;
- (c) a numerical table indicating the epidemiological status of malaria in areas under consolidation and maintenance phases;
- (d) a table showing cases of malaria imported into areas in the maintenance phase and, where possible, the country of origin of each case;
- (e) the WHO official register of areas in which malaria has been eradicated;
- (f) a supplementary list of malaria-free areas; and
- (g) a list of countries that have reported cases of *P. falciparum* malaria resistant to 4-aminoquinolines since 1960 (publication of this list has been temporarily suspended because a number of unreliable or incomplete reports have been received).

WHO is also preparing a list of international ports and airports which, although located in countries where malaria still exists, can be considered free from malaria. The participants in the meeting considered such a list to be of great importance to malaria-receptive countries. For example, the Soviet programme of chemoprophylaxis of crews is based partly on detailed knowledge of the degree of endemicity of malaria in ports of call. Publication of such a list might also act as a stimulus to countries whose malaria control operations are poor, and anti-larval measures might be improved in ports not listed as malaria-free.

A detailed report on the "Development of the Malaria Eradication Programme" is published every year as an annex to Part I of the proceeding of the World Health Assembly. Based on reports prepared by regional offices of WHO, it includes maps, numerical tables, and comments on the present status of malaria in each country reporting to WHO.

Border meetings, co-ordination meetings, and regional and inter-regional malaria conferences, held periodically, permit countries to exchange up-to-date information on their respective malaria situations and on the danger of importing malaria cases. Several neighbouring countries regularly exchange such information.

Such international information is of use only if it reaches the national health establishments that are responsible for preventing the reintroduction of malaria, and if there is a means of national co-ordination to make effective use of it. Effective use includes screening and, where necessary, follow-up treatment and remedial measures.

2.1.2 *National information*

National information concerning malaria is exchanged between the national health administration and other government departments and members of the health services of a country. The national health administration should indicate clearly the areas that are receptive to malaria, where special vigilance is necessary to prevent the re-establishment of endemicity. Information from other government departments indicates expected movements of people that might present a risk of re-establishing endemicity.

Israel prepares a weekly epidemiological report that is widely distributed to all health service personnel in the country. In addition, summaries are produced two or three times each year. Other countries issue reports less frequently. In many countries, however, reports submitted to national authorities are based on clinical information and are, therefore, inaccurate. This deficiency is reflected in international reporting.

The exchange of information between different national agencies must be continuous and must be based on general awareness of the constant danger presented by malaria. In this connexion, appropriate health education of national authorities is necessary. Representatives of the health services of countries where malaria still exists and from which malaria cases are exported should be made aware that inaccurate reporting, and lack of advice to (or regulation of) emigrants, can be dangerous. The awareness of the public should be increased and the health staff, whether governmental or private, should be appropriately trained or retrained.

In order to ensure greater reliability in diagnosis, general practitioners must be alert to the possibility of encountering malaria infections. Some countries encourage the notification of malaria by general practitioners by a system of payment when a case is notified, or when a reported case is confirmed by the national malaria service. When there is insufficient co-ordination among the different parts of the health service, the probability of incorrect or incomplete notification is greatly increased.

Co-ordination and exchange of information between the health department and the following is particularly important : immigration authorities, the department of labour, the department of agriculture, universities, air and shipping companies, tourist agencies, religious communities, and all other departments or agencies that are involved in movements of people to and from areas where malaria exists.

In countries where malaria has been eradicated from some parts but not others, persons travelling to or from areas where malaria still exists should be reported to local health authorities; the national health (or malaria) service can then maintain a close watch over such persons. Armed-forces personnel and agricultural, construction, and industrial labourers constitute the main risk.

Communication of information at national level is entirely a national responsibility, the methods by which it is disseminated and used for preventive or remedial measures depending upon the administrative procedures and level of development of the various services.

International information can be useful in preventing the re-establishment of endemicity and protecting lives only if it is speedily disseminated within a country and if the national epidemiological services are organized to use it effectively.

2.2 Laboratory methods

The detection of malaria cases among immigrants is not easy. The life cycle of malaria parasites is such that persons may harbour inapparent infections for long periods. Such carriers are potentially infective to mosquitos and may eventually be responsible for the introduction of foci of malaria. In areas where malaria has been eradicated or almost eradicated, such foci would be a serious threat under any circumstances. When large populations of non-immune persons have been built up through prolonged absence of endemic malaria, the risk of epidemics could be vastly increased.

One of the problems associated with *P. vivax* and *P. ovale* malaria is the variable latent period between the primary attack and subsequent relapses. During this period the infection is not apparent, but the host may be infective to mosquitos. Subsequent episodes of parasite activity may or may not be accompanied by significant symptoms. Relapses may not be prevented by the usual clinical treatment, and the timing and frequency of relapses may depend on the species and strain of parasite and the immune status of the host.

Although relapses in the strict sense are not a problem with *P. falciparum*, asymptomatic infections with this parasite may persist for long periods, particularly in persons with a high degree of immunity. Such persons retain their infectivity for mosquitos as long as their blood contains sufficient numbers of gametocytes. The epidemiological significance of low-density gametocytaemia has not been fully clarified.

Patterns of infectivity for *P. malariae* are less well-known, but the infection is known to persist for thirty years or more, causing either periodic relapses or persistent low-level asymptomatic infections. It seems

probable that persons harbouring such infections are at least occasionally infective to mosquitos.

Preventing the entry of such carriers into malaria-free areas requires several approaches, each of which is of limited effectiveness.

Persons particularly likely to be infected should first be identified through information obtained from national and international sources. For the initial screening of immigrants it is essential to know the status of endemicity of the disease in the areas from which they come. There should be ways to provide reliable information of this type, possibly through international health agencies. In addition, the following information should be obtained from immigrants: place of origin, areas through which they have travelled, dates of residence in such areas, whether or not they have had malaria or experienced any symptoms suggestive of malaria, and current state of health. Such information is of help in deciding on the necessity of laboratory examination, chemotherapy, or follow-up. The considerable danger of overlooking malaria when its symptoms are obscured by a more obvious infection should be stressed.

The only available method for the definitive diagnosis of malaria infection is identification of parasites in stained blood films. The study of serial blood films over a period of several days, or more intermittently as in an eradication programme, significantly increases the chance of detecting low-grade, intermittent parasitaemias, and certainly reveals heavily-infected carriers. Centrifugation of blood could increase the likelihood of detecting low-density parasitaemias. Unless completely reliable technical procedures are used by highly skilled personnel, the examination of blood films may be of little value for the detection of very slight parasitaemias. Furthermore, negative results are not conclusive, and, particularly in individuals arriving from areas of high endemicity, do not indicate that further investigation or treatment is unnecessary. In Israel, immigrants are given a single dose of chloroquine and pyrimethamine at the port of arrival, instead of a routine blood test; this treatment is designed to render carriers non-infective during the initial resettlement period. The blood of visitors from malarious countries is, however, checked. In Taiwan, the health authorities are informed of immigrants, who are then visited by medical personnel for the purpose of taking blood films; this procedure appears to be highly effective. In the USSR, testing is done on a selective basis; all febrile cases are examined, as are citizens returning from malarious areas.

Serodiagnostic methods may be of use for detecting carriers in areas cleared of malaria. Such methods are not now in common use for this purpose, although recent developments hold some promise for their future use for screening. At present they are useful principally for research and for determining endemicity and immunity levels in a population.

In recent years, an indirect haemagglutination test has been described and efforts have been made to evaluate it under field conditions; there appear to be significant problems of antigen preparation, reproducibility, and specificity to be solved. A slide flocculation test is under study but further work is required before it can be evaluated for routine use. The same applies to gel-precipitation tests.

One of the newest methods, and perhaps the one showing the greatest promise, is the indirect fluorescent antibody (FA) technique. It can be performed, however, only by highly proficient personnel and requires special equipment; it thus has limitations for widespread use as a screening procedure. By means of this test, specific malarial antibody can be demonstrated in sera from infected individuals or those who have been infected in the past. The technique involves the exposure of antigen (parasitized blood films) to a test serum, and then to a fluorescein-conjugated anti-human globulin. Malarial antibody is bound to the antigen and the fluorescein-labelled anti-serum is bound to the antibody. On exposure of the antigen slide to ultraviolet light, the presence of parasites is revealed by fluorescence. Characteristic patterns of antibody development and persistence have been described for all the human malarias. It appears that low levels of antibody persist for many months or years after the termination of a continued or severe malaria infection. However, by titration of the test serum it is possible to show, with fair reliability, a present or recent malaria infection and the species of parasite involved.

Methods of using the FA technique for large groups of people have been developed. The test can be performed on small amounts of serum obtained by venepuncture or on small amounts of dried blood collected on filter paper by finger puncture. Antigen for the test poses the most difficult problem. Thin blood films made from persons actively infected with different species of human malaria parasite are ideal, but experience has shown that selected species of simian malaria parasite are quite acceptable. Because of its difficulties, the method is more suitable for central laboratories than for smaller installations. This restricts its usefulness for immediate screening but not its value for follow-up studies of persons entering malaria-free areas. Further experience is necessary before its usefulness as a routine method can be determined. It seems that the FA method could be a useful adjunct to other screening measures, particularly in programmes that include careful follow-up and re-examination of potential carriers after their settlement in malaria-free areas.

Regardless of the methods used to detect malaria infections in persons entering malaria-free areas, the only reliable ways to protect such areas are presumptive treatment of persons who enter and continuous vigilance. The extent to which such treatment should be administered depends upon the epidemiological features of malaria in the areas of

origin and destination. Drugs and dosages should be carefully selected so as to achieve the desired schizontocidal and sporontocidal effects.

3. CO-ORDINATION BETWEEN IMMIGRATION AUTHORITIES AND HEALTH SERVICES

The tasks of border authorities in preventing the re-introduction of malaria vary with the type and number of people crossing the border. In order of increasing risk to the receiving country, such people can be classified as follows : (1) international travellers, (2) immigrants, (3) migratory workers, and (4) people crossing uncontrolled borders by land or arriving at uncontrolled coastlines.

3.1 International travellers

Few countries apply screening procedures at their borders to international travellers other than returning nationals. This is the maximum allowed under the International Sanitary Regulations. Border authorities should, however, inform travellers of the risk of malaria as they either leave malarious areas or arrive from such areas. These authorities can do this only if they are informed of the areas in their own country and the rest of the world that are malarious. To this end, co-ordination with the central health service of the country, which receives regular information from the malaria service (if there is one) and from international sources is essential.

National health services should also co-ordinate their activities with other governmental and nongovernmental agencies that are concerned with tourism.

A map showing the current distribution of malaria could be made available to border stations and tourist bureaux to aid in providing advice.

It is sometimes desirable for border authorities to obtain information on the destination of travellers from areas of high endemicity, although this may be difficult to do. If such information is obtained it should be passed on to the health services, which should institute appropriate vigilance measures.

3.2 Immigrants

There are two general methods of screening immigrants at borders, both of which require co-ordination between border health authorities (quarantine) and national health services (epidemiological surveillance).

(a) The immigrant can be examined and/or treated as he enters the country. If this is done by the health authorities at the border without

notification of local health authorities and those responsible for epidemiological surveillance, follow-up is impossible. As a temporary measure, some countries routinely administer a single-dose drug treatment to immigrants from highly endemic areas; such immigrants are subsequently followed-up by the local health services.

(b) Immigrants from malarious countries can be examined before departure from their home countries. Since all cases of malaria cannot be detected in this way, the destinations of immigrants from highly endemic areas should be given by border or immigration authorities to the local health service so that follow-up measures can be taken.

3.3 Migratory workers

Migratory workers pose a more serious problem than the preceding groups because they usually remain for a longer time in receptive areas. In most areas where malaria has been eradicated there is sufficient control of border crossings so that advance warning of the entry of potentially infective persons can be given. Health authorities can then either examine such persons or exercise vigilance in the area of their destination. Several groups of persons not normally regarded as migrants are liable to re-introduce malaria. Of particular importance are merchant seamen and airmen whose vessels stop in ports or airports in malarious areas and returning military personnel. Civilian health authorities should be notified, by the appropriate government agency, of the destination of troops returning from malarious areas.

3.4 People crossing uncontrolled borders

Persons who cross uncontrolled land borders or coastlines present the greatest threat of the re-introduction of malaria. Furthermore, this problem is, by its very nature, the least amenable to solution. It should be the responsibility of border authorities to report any knowledge of such crossings to health authorities so that vigilance can be increased in the areas concerned. Persons who cross borders in this way can be covered by the appropriate phase of the recipient country's malaria eradication programme; this is the only method of control that can be practised. An efficient case detection system should identify such problem groups.

3.5 General considerations

For all groups certain generalizations are possible. The more advanced the stage of eradication, the greater the need for alertness and vigilance. It is of particular importance to obtain, by means of appro-

priate health education, the collaboration of the entire population of areas where malaria has been eradicated and where uncontrolled immigration may occur, so that adequate vigilance measures can be instituted.

The intensity of the vigilance and the measures taken at the border must be appropriate to the epidemiological situation in the area from which the groups are coming and the receptivity of the area to which they are going.

3.6 Countries where malaria has been eradicated in some areas only

Where malaria has been eradicated from part but not all of a country an epidemiological boundary exists between the malarious and non-malarious areas. The foregoing discussion is applicable to the movement of persons across this epidemiological boundary no less than to movement across international boundaries; in this case, however, the national authorities are free to make their own rules. Of great importance would be the regulations issued to soldiers, labour forces, and similar groups, and the co-operation achieved with them.

4. INTERPRETATION OF THE INTERNATIONAL SANITARY REGULATIONS

The International Sanitary Regulations provide the maximum measures that a state may apply to international traffic for the protection of its territory. Their essential aim is to ensure maximum security against the international spread of disease and minimum interference with world traffic.

The only measure dealing specifically with malaria is article 102, which refers to the disinsection of ships and aircraft that are leaving areas where malaria transmission occurs and that are bound for receptive areas. However, the general provisions of other articles can be applied to people. The Committee on International Quarantine has given the following interpretations of the Regulations with reference to malaria.¹

4.1 International travellers

Persons on international journeys should not be subjected to any special sanitary measures. Nevertheless, tourists and businessmen should be offered information on how to protect themselves in malarious countries (e.g., information on danger areas and on the use of screens, insect repellents, and chemoprophylaxis), on what they should do if they should develop fever after returning to their home countries, and on particular risks that may be present (e.g., on scientific and hunting expeditions).

¹ *Off. Rec. Wld Hlth Org.*, 1958, **87**, 413.

Medical officers responsible for crews of ships and aircraft should be adequately trained in the diagnosis and treatment of malaria and in measures of personal prophylaxis. Owners and operators should ensure that all members of their crews who visit ports and airports in malarious areas are given supervised suppressant treatment for an adequate time.

No sanitary document other than those provided for in the Regulations may be used (article 100). Information on the origin of international travellers and their movements prior to disembarkation, when required, may be obtained through questioning or passport inspection. Article 36.3 stipulates that "where a health administration has special problems constituting a grave danger to public health a person on an international voyage may, on arrival, be required to give a destination address in writing".

Recommendations for chemoprophylaxis of international travellers entering malarious areas depend largely on epidemiological conditions in such areas. Such advice should be given to tourists before departure so that they can protect themselves on arrival. Travel agencies and carriers should be invited to recommend prophylactic treatment to international travellers, where necessary. International uniformity of such procedures is desirable.

The health administration of a country that is receptive to malaria may wish to give information to persons arriving from malarious areas; the use of warning cards may be considered. The health administration should invite the co-operation of carriers and agencies concerned with international traffic.

Consultation on the procedures to be followed by the health administrations of both the receptive and the malarious countries is necessary. WHO is to be informed of such arrangements (articles 103 and 104).

4.2 Special groups

Special measures may be applied to migrants, seasonal workers, and persons taking part in periodic mass congregations (article 103). Also included under this provision are the labour forces of large enterprises; organized groups, some of which are provided with a medical service, such as troops; nomadic or semi-nomadic groups; less organized groups that may be leaderless, such as pilgrims; labourers and agricultural workers who soon disperse after entry into a country; and groups such as tribes that cross borders irregularly.

Under article 103, such groups may be subjected to additional sanitary measures conforming with the laws and regulations of each state concerned, and with any agreement between such states. Each state must notify WHO of the provisions of any such laws and agreements.

Special measures applied to such groups may include blood tests and mass administration of drugs to all persons, to ensure that they are not infectious to anopheline mosquitos with or without further medical treatment. If an individual refuses to submit to such measures he may be refused entry.

Appropriate anti-mosquito measures should be taken in frontier zones and centres where these special groups assemble.

There should be full exchange of information on movements of population groups, on the susceptibility and resistance of anopheline vectors to insecticides, and on confirmed resistance of malaria parasites to drugs.

The control of mosquitos in ports and airports deserves attention; article 102 provides for the disinsection of ships and aircraft when this is considered necessary.

With the increasing development of international traffic, there may be some question as to when national laws and regulations are applicable to travellers staying in a given country for prolonged periods.

Co-operation between health administrations and agencies responsible for tourism is desirable in order to provide accommodation in areas free from the risk of infection, or, where danger of infection still exists, to give adequate warnings and advice on preventive measures.

Since control of an entire border is sometimes unattainable and control procedures at ports and airports are not always completely reliable, particularly with the increasing volume of traffic and with the limited facilities available, health administrations may wish to deal with imported cases by means of adequate surveillance. All concerned — e.g., administrations, travel agencies, carriers, and travellers themselves — should be made aware of their responsibility to take all possible measures to avoid the spread of malaria.

5. PERSONS ENTERING OR LEAVING MALARIOUS AREAS

Information and advice should be given to persons entering or leaving malarious areas regarding dangers to which they may be exposed. The individual traveller should be able to carry out, when necessary, prophylactic measures to protect himself and his family, and to protect countries against the re-introduction of malaria. The development of such advisory services is a joint responsibility of the countries of origin and destination.

It is recommended that WHO consider the possibility of developing procedures for obtaining, and circulating to the health authorities of all countries, information on the status and distribution of malaria in individual countries. It is also recommended that countries attempt to standardize the instructions given to international travellers, develop services

for disseminating such information, and establish procedures for the follow-up observation and treatment of infected persons.

Travellers could be given pamphlets and nontechnical explanations of the seriousness of malaria, the way it is spread, its incubation period, the possibility of late relapse, and protective measures that should be taken. Such briefing should emphasize the necessity of appropriate chemoprophylaxis and of continuing such treatment for four weeks after departure from malarious areas. The desirability of providing a supply of anti-malarial drugs should also be considered. Travellers should also be advised to use insecticidal sprays and repellents and, when visiting highly malarious areas, mosquito nets. They should also be advised to seek medical advice if illness should develop. Particular care should be taken with children.

Travellers should be advised that if any febrile illness (other than a transitory, mild episode) should develop within 6 months of leaving a malarious area, they should tell their physicians they have come from a malarious area, and suggest that the condition might be malaria and that blood films be taken and sent to a competent laboratory without delay. In addition, persons leaving malarious countries might well be given cards indicating that they have resided in a malarious area.

It is recognized that it may be difficult to put the above suggestions into effect among certain groups such as crewmen.

Migratory peasants, who often move across borders where there are no immigration/emigration or health posts, pose a serious problem. The individual approach often cannot be used, and the degree of understanding of the group depends on health education in their country of origin. It is essential that receptive countries be advised, whenever possible, of such movements by the country of origin.

As previously noted, the giving of advice to travellers should be a co-operative effort, at the national level, of many different agencies and individuals, including national health and vaccination centres, practising physicians, and travel agencies.

6. TRAINING OF PERSONNEL

Training in malaria must continue in all countries as long as the disease persists in any part of the world. In countries that have eradicated malaria, such training and retraining of medical and paramedical personnel is subject to the following limitations :

(a) the necessity of integrating malaria services and their staff into the general health services (this involves the assignment of staff to more comprehensive duties, for which special training or retraining may be required);

(b) diminished interest in malaria, and usually a decrease in funds — although these are necessary for the maintenance of vigilance and for the development of rural health services and epidemiological services;

(c) a sense of frustration among staff trained to deal with a disease that no longer exists in the country; and

(d) public demand for other types of health care, and the consequent establishment of other priorities.

Steps should be taken at an early date to ensure the gradual integration of the malaria services into the general health services.

Since the prevention of re-establishment of malaria is primarily an epidemiological problem, malaria-service personnel should preferably be retrained and assigned to epidemiology sections of the general health service.

Proper training and retraining of medical and paramedical personnel, including laboratory workers, is indispensable in programmes to prevent the re-introduction of malaria. Such training should be appropriate to the state of development of each country, its receptivity to malaria, and its health priorities. For this reason, it does not seem advisable to establish general training procedures.

In selecting subjects in which former members of malaria services are to be trained, attention should be given not only to the future duties of such personnel, but also to their past experience. Personnel would have greater interest in such retraining if it were polyvalent. The training programme should also cover administrators, to ensure that they are alert to the need for vigilance, the development of rural health services, and consequent administrative and budgetary implications.

The nucleus of the malaria service that remains must play the most important role in training in malaria. It is also responsible for keeping the public informed of the danger of re-introduction of the disease. Training in malaria should be specific and practical, emphasizing not theory but detection, treatment, and notification. The nucleus of the former malaria service is responsible for the confirmation of any malaria cases detected (including verification of microscopic diagnosis), for epidemiological investigation, and for supervision of remedial measures (including follow-up of all cases detected).

For physicians, malaria training should begin in medical schools, which should retain malaria among the subjects for examination. Special short courses should be given to physicians who are to work in receptive areas, areas where malaria cases are likely to occur, or health services at ports, airports, and border-crossing posts. In this connexion, it is important that national authorities make up-to-date information on geographical epidemiology available to all physicians at the operational level.

When examining patients, physicians should routinely ask specific questions on travel abroad — e.g., where the patient has been during the last two or three years. The orientation of physicians in this respect should begin in medical schools.

Supervision and retraining of health-service microscopists is necessary, since few of them are properly trained to detect malaria parasites in the blood. The training — or retraining — of nurses and sanitarians should also be considered. It should be noted that these remarks refer primarily to personnel who have not worked in malaria services. It is assumed that malaria-service personnel have received adequate training to enable them to cope with new situations arising from the disappearance of malaria as an endemic disease.

It is important that the results of training and retraining be evaluated at an early date so that any shortcomings may be corrected.

In the late consolidation and maintenance phases of malaria eradication, the examination of large numbers of negative slides may cause frustration in microscopists, thereby reducing their efficiency. For this reason, it is advisable to include some blood films known to contain human plasmodia among those to be examined.

7. SPECIAL PROBLEMS

7.1 Importation of cases resistant to 4-aminoquinolines

Strains of *P. falciparum* resistant to treatment with 4-aminoquinolines have been recognized in the northern part of South America and in South-East Asia. The evidence suggests that these have been multifocal in origin, although the way they are produced remains obscure.

As the 4-aminoquinolines are routinely used in the radical cure of *falciparum* infections, the importation of strains of this parasite that are resistant to these drugs could constitute a threat to countries in the maintenance phase of malaria eradication. The world shortage of quinine, another effective drug, may increase the seriousness of such a threat.

Infections that would be epidemiologically dangerous as imported cases are those showing adequate clinical response to chloroquine but persistence of small numbers of parasites. Such infections are comparatively few in number. Clinical symptoms are more likely to occur in non-immune persons (in whom the probability of detection is, therefore, greater) than in those who are partly immune.

Observations indicate that resistant strains have not spread very far *en masse*, although the spread of a few foci of resistance across borders has been noted where there has been unimpeded movement of people. However, a few cases infected with resistant strains from both Asia and

South America have been found in distant countries such as Australia and the USA; some of these have been fatal because of inexperienced therapy.

Patterns of travel by potentially dangerous groups can often be identified, and further analysis of such travel patterns (at least for air travel) may well be performed by computer methods. Knowledge of such patterns is of assistance in the institution of precautionary measures. Plans have been and are being made for international discussion of co-ordinated action by countries likely to export malaria cases and countries likely to be receptive to malaria.

The possibility of resistance should be suspected in all cases coming from countries in which resistant strains are known to occur. It should also be suspected if fever and a positive blood film recur in a patient following treatment, or if symptoms persist despite treatment. In such cases, the patient should be admitted to a hospital where treatment can be supervised and the clinical and parasite response to therapy can be observed.

The preventive measures necessary when an imported resistant infection is discovered depend upon the receptivity of the area. In receptive areas, spraying with a residual insecticide should be performed immediately to prevent transmission; this is a routine procedure when any imported case of malaria is found. If a focus has been established, spraying and, if necessary, antilarval measures should be undertaken to interrupt transmission, and all cases of malaria should be admitted to hospital for treatment; after discharge, such patients should be adequately followed up. Over-all vigilance should be increased and repeated mass blood examinations may be necessary.

When a person is found to be infected with a resistant strain of malaria parasite, his country of origin should be notified. Countries where resistant strains are known to occur should intensify their efforts to eradicate malaria.

Physicians should be notified that they may find cases of drug-resistant malaria and of the countries likely to export such cases. They should also be informed of the correct method of treatment of such infections.

Although WHO no longer publishes a list of countries in which strains resistant to 4-aminoquinolines have been reported, because of the unreliability of some published reports, it is to be hoped that it will be possible to resume this important activity on a sound basis.

Areas in the consolidation phase of a malaria eradication programme lack over-all insecticidal protective cover and are thus receptive to resistant (and other) strains of parasites. Protective and remedial measures are, therefore, just as necessary in such areas as in areas in the maintenance phase.

Insufficiently supported assertions of drug resistance should not be used as an excuse for operational failure.

7.2 Crossing of unchecked borders

Malaria may readily be re-established by migrants crossing unchecked borders, including seacoasts. This possibility is of particular concern in countries that, although free of malaria transmission themselves, are adjacent to other countries that are not.

To a lesser extent, malaria may be re-introduced by the entry of infected anopheline mosquitos, usually by flight (or carriage by the wind) from near-by areas. Sometimes, however, such mosquitos may come from distant areas in vehicles such as aircraft.

The extent of population movement within and between countries has been shown to be much greater than was thought.¹ It is apparent that only a small proportion of migrants cross borders at recognized posts. Those who are most easily screened at border posts on major roads and at seaports and airports are usually individual travellers or families who can readily be taken care of by regular immigration and health arrangements. Much larger groups, such as pilgrims and those who migrate seasonally or irregularly for agricultural and other purposes, are a cause of greater concern. Some such groups frequently avoid — accidentally or deliberately — recognized posts and ports of entry.

The problem is of principal concern to a country into which unchecked immigration occurs, but it may also concern the country of origin.

Countries that receive immigrants have great interest in applying health checks, whereas countries from which they emigrate have little. If, however, immigrants are forbidden entry to a receptive area without certain health documents, a demand is created for the necessary service in their country of origin. Unfortunately, considerable technical difficulties must be overcome before such a service can be provided in the case of malaria.

It has been suggested that malarious countries from which there is considerable emigration should take measures to eliminate the vector in ports and other areas where emigrants may congregate prior to departure. Anti-mosquito measures to be applied at international ports and airports, and international arrangements that might prevent importation of sources of infection across borders, were considered in the tenth report of the WHO Expert Committee on Malaria.²

Such problems, and possible solutions to them, may be summarized as follows :

(1) In receptive countries where eradication of malaria has been achieved or is well under way, screening of those who cross boundaries or seacoasts may or may not be practicable. Many countries cannot

¹ Prothero, R. M. (1965) *Migrants and malaria*, London, Longmans Green.

² *Wld Hlth Org. techn. Rep. Ser.*, 1964. 272.

afford to set up the extensive supervisory network that is necessary. However, in the areas to which most of the migrants proceed, it is essential that vigilance be increased and that certain special measures be taken. Continual barrier spraying may be necessary to prevent the spread of infected anopheline mosquitos across boundaries.

(2) In countries that export malaria cases, where the disease is often unchecked and there is little incentive to prevent its export, it might be possible to obtain, by international agreement, the strengthening of protective measures, including residual spraying and the prophylactic treatment of known emigrant communities.

It is obviously extremely difficult to exert any form of control on emigrants leaving by routes other than those subject to routine supervision. Increased public awareness of the malaria problem may be important in this connexion, and it should be sought through health education, particularly of schoolchildren.

Border malaria problems cannot be solved unilaterally, and it is reasonable to request any country with malarious areas—which may adversely affect a campaign in a neighbouring country—to attack such areas with all the means at its command. In this connexion, regular meetings between neighbouring countries are essential.

8. SPECIAL PREVENTIVE MEASURES IN RECEPTIVE AND VULNERABLE AREAS

Once a country has eradicated malaria the re-establishment of transmission depends on: (a) the receptivity of the country—that is, the extent to which anopheline vectors and ecological conditions favourable to transmission are present; and (b) its vulnerability—that is, the extent to which it is challenged by infective sources (imported cases of malaria or infected anopheline mosquitos).

The twelfth report of the WHO Expert Committee on Malaria¹ defined three degrees of receptivity: (1) transmission possible, (2) transmission easily resumed, and (3) transmission likely to lead to explosive outbreaks. Some countries, such as the USSR, classify areas simply on the basis of whether there is a great risk or a small risk of re-establishment of malaria.

Such a classification is important in that it permits selection of measures that are appropriate to a given situation.

In countries where malaria was originally highly endemic, general health services are often insufficiently developed, even when the main-

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1966, 324.

tenance phase is achieved. In some such countries the integration of the malaria service with general health services is in fact a process of developing a rural health service from the malaria service. Countries with insufficiently developed general health services will remain highly receptive, necessitating extreme vigilance. This should include the following activities :

- (1) detection of all malaria cases, including those undetected in the earlier phases of eradication; the method used (active and/or passive case detection) and the frequency of active case detection will depend on the structure of the health services of the country and on its malaria history, receptivity, and vulnerability;
- (2) administration of radical treatment to each case discovered;
- (3) compulsory notification of cases;
- (4) thorough epidemiological investigation, including (a) careful classification of each case by origin of infection and species of parasite (special attention should be given to introduced cases that occur after the importation of a case); (b) survey of the contacts by blood examination (repeated examination should be made of febrile cases and those showing symptoms suspected as being caused by malaria); (c) follow-up of all cases; and (d) the use of the fluorescent antibody test if drugs have been used by the people prior to the epidemiological investigation;
- (5) entomological investigation, including (a) a search for adult anopheline mosquitos, their identification, and determination of their density, sensitivity to different insecticides, and vectorial capacity; and (b) the identification of larvae and a search for their breeding places;
- (6) proper remedial measures as required by the entomological situation (as a precaution, routine antilarval measures may be taken in receptive and highly vulnerable areas, such as certain ports);
- (7) maintenance of a state of readiness to take all necessary measures (including training and retraining of medical, general health service, and malaria personnel);
- (8) regular dissemination, both nationally and internationally, of information on the malaria situation;
- (9) periodic reassessment of the degree of receptivity to malaria;
- (10) identification of groups of persons who constitute the principal danger of re-introducing malaria.

In applying these measures, consideration must be given to the structure of the country, the original features of local malaria, the degree of receptivity, and the number of imported cases.

Every country has its own methods of preventing the re-introduction of malaria, but the necessity of the following should be emphasized :

- (a) maintenance of the health-service budget at least at the same level as before eradication;
- (b) maintenance of the nucleus of a malaria-eradication staff at a high level in the health service; and
- (c) training of general health service personnel in vigilance procedures and "refresher" training of malaria eradication personnel.

When a country has been entered in the WHO official register of areas freed from malaria, reports must be submitted to the Organization on : (a) malaria cases found during the last six months; (b) the country of origin of each imported case; (c) the history of each indigenous, introduced, induced, or relapsed case; (d) measures taken, such as epidemiological investigation, radical treatment, and spraying; and (e) preventive measures taken in connexion with immigrants and other migratory persons within the country and on its borders.

9. SUMMARY AND CONCLUSIONS

9.1 Application of preventive measures

There is need for improvement in the following measures to prevent the re-introduction of malaria in countries that have eradicated the disease, particularly where the receptivity is high : (a) regular polyvalent home-visiting services; (b) co-ordination between the various national services dealing with immigrants or international travellers; (c) notification of cases of malaria; (d) dissemination of information on the status of malaria in the world; (e) analysis of the receptivity of formerly malarious areas; and (f) prompt and competent examination of blood films.

The risk of re-introduction of malaria could be reduced if countries where it still exists would provide departing travellers with notices warning that they may be infected with the disease.

9.2 Screening procedures

9.2.1 *Information from national or international sources*

(1) Compulsory notification of malaria is essential in receptive countries if they are to remain free from the disease.

(2) Information on the world status of malaria should be disseminated by the national health authorities that receive it to all levels

of the health agencies that are responsible for exercising vigilance against the re-introduction of the disease.

(3) In formerly malarious countries, national information should be made available by the central malaria/epidemiological unit to all agencies responsible for vigilance. This information should indicate (a) the receptivity status of all areas; (b) areas where malaria transmission is, or may be, still occurring; and (c) all areas that are vulnerable either because they are contiguous to malarious areas of neighbouring countries, or because they receive groups of immigrants who constitute a particular risk.

(4) There should be a continual exchange of information between various government departments and interested unofficial bodies on situations likely to produce particular risks of re-introduction of the disease, particularly in countries where part of the national territory is still malarious.

(5) Figures relating to the incidence of malaria in various countries often vary, depending on the source that provides them (e.g., an official health statistics department or a malaria service), and better methods of checking such figures are necessary. All cases notified from areas in consolidation and maintenance phases should be investigated and verified (or rejected) before they are entered in the official health statistics.

9.2.2 *Laboratory methods*

Laboratory methods are not infallible for screening potential malaria carriers entering a country, and more reliable, rapid, and inexpensive diagnostic methods are needed.

Vigilance of the types indicated in the twelfth report of the WHO Expert Committee on Malaria,¹ and reliable and rapid microscopic diagnostic services, are the most reliable safeguards against the re-establishment of malaria.

Blood films taken from immigrants suspected of being infected should be examined promptly.

9.3 **Co-ordination between immigration and health authorities**

(1) Checking at borders cannot detect all cases of malaria.

(2) All vigilance over mass movements of people from one country to another should be based on epidemiological assessment of the areas of origin and destination.

(3) Local vigilance is of utmost importance; the methods used depend upon national and local circumstances.

¹ *Wld Hlth Org. techn. Rep. Ser.*, 1966, 324.

(4) Malaria cases should be promptly notified to the organization responsible for the control and eradication of the disease so that adequate epidemiological investigation can be made.

(5) Efforts should be made to ensure an adequate two-way flow of information between border authorities and national health administrations.

(6) All types of international travel can serve to introduce malaria, but in general the casual international tourist is less important than immigrants and migratory workers, and co-ordination between border authorities, national health services, tourist services, and national labour services should be greatest in the case of such migrants. Individual travellers should, however, receive adequate health information.

(7) Shipping companies should be alerted to the problem of malaria and should be informed of prophylactic and therapeutic procedures. Health education of crews should be undertaken by each country.

(8) WHO should continue discussions with international and non-official organizations dealing with transport in order to develop better collaboration and dissemination of information.

9.4 International Sanitary Regulations

(1) Malaria is a serious international threat but is not a quarantinable disease. However, the International Sanitary Regulations and the interpretation given by the Committee on International Quarantine provide basic principles for dealing with malaria in international traffic.

(2) Control of the re-introduction of malaria must be based primarily on the detection of infected persons. The re-introduction of vectors by international traffic is of minor importance, although this depends on epidemiological circumstances. Vector control should be carried out at ports, airports, and other points of entry and on board ships, aircraft, trains, and road vehicles coming from malarious areas.

(3) International travellers (tourists) should not be subjected to any compulsory antimalaria measures. Information on preventive measures should, however, be given to them for their own protection when they enter or leave malarious areas, together with warning cards instructing them how and where to report should they develop fever. Transport companies should be responsible for supervision of preventive and curative measures among their crews.

(4) Special groups of migrants, seasonal workers, and labour forces from malarious areas should, when entering receptive areas, be submitted

to the special measures (e.g., blood examination and/or drug treatment) allowed under the International Sanitary Regulations. Such requirements could be made conditional for the issue of entry permits.

(5) The health administrations of both infected countries of origin and receptive countries of destination are responsible for the issue of instructions to travellers and labour groups. Carriers, tourist agencies, and travellers should be made aware of their responsibilities and their co-operation should be invited.

(6) Consultation is desirable between infected and recipient countries for co-ordination of control measures, exchange of epidemiological data, and notification of international movements of labourers and other groups. Vigilance is important in receptive countries, particularly when uncontrolled border areas and coastlines make the control of all arrivals difficult.

(7) With the increase of tourism and other traffic at points of entry, universal screening may become impracticable; health authorities may then have to use screening on a selective basis.

9.5 Persons entering or leaving malarious areas

It is essential that travellers to and from malarious areas be given advice, preferably written, on the malaria hazard and the precautions they must take to avoid the disease.

Travellers should seek medical advice abroad or at home if they develop fever. Diagnosis is likely to be more rapidly made if attending physicians in non-malarious countries are informed by travellers that such fevers may be due to malaria, and that blood films should be taken.

9.6 Training of personnel

Training and retraining of medical and paramedical personnel, including microscopists, in malaria must continue as long as the disease persists in any part of the world. A central specialized nucleus staff should be established to ensure that such training is carried out properly and the public is kept aware of the risk of re-introducing malaria.

In order to discover imported cases of malaria it is essential that information be obtained from all patients on any travelling they have done. For this purpose appropriate questions must routinely be asked when case-histories are taken.

When former malaria staff are incorporated into general health services, they should preferably be assigned to epidemiological sections.

9.7 Special problems

9.7.1 *Cases resistant to 4-aminoquinolines*

Importation of any malaria case into a receptive area is a risk, but the importation of a strain resistant to 4-aminoquinolines constitutes a special problem.

Such strains do not appear to have spread very far, although they have crossed national borders and in some cases have travelled long distances.

Where there are recognizable patterns of travel by groups of people, international co-operation is possible to enable countries of origin and destination to take precautionary measures. Such co-operation already exists between a few countries, but it could well be extended.

When resistance is reported, cases should be confirmed and treated in hospital.

Cases of malaria resistant to 4-aminoquinolines need competent treatment and thorough epidemiological investigation, and every effort should be made to prevent or interrupt transmission in receptive areas. If the case is imported, the country of origin should be notified.

Countries that harbour resistant strains should intensify their efforts to eradicate the disease.

9.7.2 *Transit of unchecked borders*

(1) There appears to be no simple solution to the problem of immigration across unchecked borders by potential malaria carriers.

(2) In receptive countries reinforced vigilance is essential in areas of destination to prevent the re-introduction of malaria by migrants from endemic foci.

(3) Regular meetings between the health authorities of neighbouring countries help to clarify the nature and extent of such population movements, and the preventive measures to be adopted.

(4) In malarious countries, health education of migratory populations may ultimately prove fruitful.

(5) Migration of potentially infective anophelines should be checked by anti-mosquito measures, including barrier spraying where necessary.

9.8 Special preventive measures in receptive and vulnerable areas

In receptive and vulnerable areas of a country that has been freed from malaria, adequate vigilance is necessary to prevent re-importation of malaria. Such activities must be supervised by specialized staff,

irrespective of the way the malaria staff have been integrated into the general health services.

Vigilance measures will vary in details according to local situations, including receptivity, but they must include :

- (1) prompt detection, notification, and treatment of all cases of malaria;
- (2) epidemiological investigation of cases;
- (3) appropriate preventive and/or remedial measures;
- (4) continued entomological activities, including assessment of vectorial capacity and application of antilarval and imagicidal measures where indicated;
- (5) retention of the nucleus of a malaria staff within the general health service;
- (6) adequate funds for maintenance phase activities;
- (7) training in malaria of medical and auxiliary personnel; and
- (8) assessment of results obtained by measures (1) to (6).

The effectiveness of a health service in preventing the re-establishment of malaria depends upon a constant awareness of the problem, which must be maintained by education of the general public as well as medical practitioners and health administrators.

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