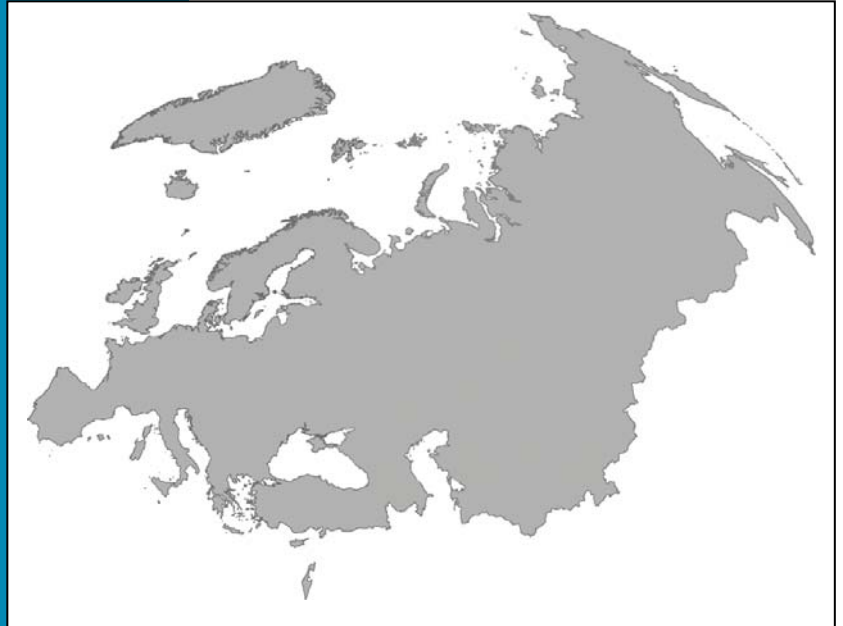




World Health
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Europe



By: Mikhail Ejov
Vladimir Davidyants
Andrei Zvantsov

Regional framework for
prevention of malaria
reintroduction and
certification of malaria
elimination
2014–2020



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ABSTRACT

This framework for prevention of the reintroduction of malaria and certification of countries as free from malaria is intended for health policy-makers, heads of national malaria control programmes, heads of epidemiological, parasitological and entomological departments of the ministry of health epidemiological services, and specialists from other ministries and agencies involved in the implementation of programmes for malaria elimination and prevention of malaria reintroduction in central Asia, the south Caucasus, Turkey and some European countries.

The document outlines the key issues related to possible resurgence of malaria in the post-elimination period, the goals and objectives of the programme, and key approaches and measures to prevent malaria reintroduction, as well as scientific, operational, organizational and methodological aspects of the process of certifying countries free from malaria. The guidelines described in the document are intended to help health policy-makers and managers of malaria control programmes to plan, organize and implement measures aimed at preventing malaria reintroduction and at the certification of malaria elimination.

Keywords

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Contents

	Page
Acknowledgements.....	iv
Summary	1
Introduction.....	3
Prevention of malaria reintroduction in the post-elimination period.....	4
Transition from elimination to prevention of reintroduction of malaria.....	4
Importation of malaria and its consequences.....	5
The risk of malaria reintroduction and associated factors.....	6
Regional framework for prevention of malaria reintroduction.....	8
Goal of the framework	8
Objectives of the framework.....	8
Objects of intervention.....	8
Main approaches and activities for preventing malaria reintroduction	8
Certification of malaria elimination.....	14
Background	14
Requirements and procedures for certification	14
Timeline and criteria for certification	16
Stages of the certification process.....	17
References	20
Bibliography.....	21

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Summary

In the WHO European Region, the period from 2005 to 2013 witnessed not only a reduction in malaria incidence in all affected countries and prevention of resurgence in countries and areas where the disease had been eliminated, but also complete interruption of transmission in most countries with certification of malaria elimination in some of them. By 2013, local malaria transmission had been interrupted in eight of the 10 countries that signed the Tashkent Declaration (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation, Turkmenistan and Uzbekistan). Tajikistan and Turkey had also made significant progress in reducing the number of malaria cases, and interruption of local transmission can be expected in these countries in the near future. Armenia, Kazakhstan and Turkmenistan were certified and/or declared as malaria-free in 2011, 2012 and 2010 respectively.

Countries that have become malaria-free now face a new challenge – development of national programmes for prevention of malaria reintroduction. Malaria reintroduction is the occurrence of introduced cases (that is, cases of first-generation local transmission that are epidemiologically linked to a confirmed imported case) in a country or area where malaria had been eliminated. The programme transition from elimination to prevention of reintroduction is possible only when effective countrywide surveillance has shown that malaria transmission has been interrupted, that there are no locally acquired cases of malaria anywhere in the country and that all reported cases of malaria have been imported.

Continuous importation of malaria from endemic countries, and the consequent recent resumption of local malaria transmission in limited areas of Georgia, Greece and Turkey, requires constant vigilance, assessment of the current and potential epidemiological situation, and – when necessary – prompt and appropriate interventions. The risk of malaria resurgence in a country depends on the combined effect of receptivity and vulnerability. Receptivity is a function of the presence of local vectors and the existence of ecological and climatic conditions favourable to the transmission of malaria. Vulnerability depends on the probability of importation of malaria parasites into the country. Strategic plans and practical approaches for preventing malaria resurgence in a country should be developed on the basis of assessment of these risks.

The purpose of a programme for prevention of malaria reintroduction is to maintain a country's malaria-free status by preventing the occurrence of introduced cases and indigenous cases secondary to introduced cases. The main objectives of the programme are: early detection, notification, diagnosis and treatment of all cases of malaria; determination of the probable causes of reintroduction of malaria transmission; urgent response in the event of renewed malaria transmission; and determination of the levels of receptivity, vulnerability and resulting risk of malaria reintroduction.

The programme should include not only goals, objectives and key strategic approaches, but also a set of specific activities for implementation. The choice of activities should be based on assessment of the local situation. If receptivity and vulnerability in the area are both low, the main emphasis should be on improving the ability of general physicians and other general health workers to diagnose malaria as soon as possible. Epidemiological investigation of each confirmed imported case of malaria, along with adequate and prompt prevention and treatment, can often be

sufficient to prevent the reintroduction of local malaria transmission. Where levels of receptivity and vulnerability are raised, these measures must be supplemented by active detection of malaria cases. In areas of high vulnerability, malaria vector control activities aimed at reducing the level of receptivity are advisable and often essential. Vulnerability may be reduced by providing access to diagnosis and treatment of malaria for the entire population, including immigrants and refugees.

National programmes for prevention of malaria reintroduction should continue until the goal of malaria eradication, that is, complete interruption of transmission of all forms of human malaria in all countries of the world, has been reached.

Introduction

In 2002, all Member States endorsed WHO Regional Committee for Europe resolution EUR/RC52/R10 on scaling up the response to malaria in the WHO European Region (1). This resolution urged countries in the Region facing resurgence of malaria to continue to reduce the burden from the disease. Malaria control activities were therefore strengthened through the Roll Back Malaria regional strategy, launched in 1999.

By 2005, the malaria resurgence had been contained and incidence of the disease had been reduced to such a level that the goal of interruption of transmission had become feasible throughout the Region. The ministers of health of Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation, Tajikistan, Turkey, Turkmenistan and Uzbekistan were therefore able to sign a policy document entitled *The Move from Malaria Control to Elimination in the WHO European Region*, better known as the Tashkent Declaration, which expressed a political commitment to begin the process of malaria elimination in their countries (2).

The period between 2005 and 2013 witnessed not only a reduction in malaria incidence in all affected countries and prevention of resurgence in countries and areas where the disease had been eliminated, but also complete interruption of transmission in most countries with certification of malaria elimination in some of them. By 2013, local malaria transmission had been interrupted in eight of the 10 countries that had signed the Tashkent Declaration: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, the Russian Federation, Turkmenistan and Uzbekistan. The Declaration provided a political base that helped the WHO Regional Office for Europe to launch, in 2006, a new regional strategy to eliminate malaria in the Region by 2015, which is being successfully implemented. Tajikistan and Turkey have also made significant progress in reducing the incidence of malaria, and interruption of local transmission in these countries can be expected in the near future. Malaria-free status was granted to Armenia, Kazakhstan and Turkmenistan in 2011, 2012 and 2010, respectively.

Unfortunately, 2011 and 2012 also saw renewed malaria transmission – in Georgia (isolated cases) and in Greece and Turkey (localized outbreaks) as a result of malaria importation from endemic countries (Afghanistan, India and Pakistan) – and the subsequent re-establishment of local malaria transmission in limited areas of these countries.

Prevention of malaria reintroduction in the post-elimination period

Transition from elimination to prevention of reintroduction of malaria

Malaria elimination is defined as interruption of local malaria transmission in a country or a specific geographical area. Malaria reintroduction is the occurrence of introduced cases (cases of first-generation local transmission that are epidemiologically linked to a confirmed imported case) in a country or area where the disease had previously been eliminated.

Countries that have eliminated malaria need to make every effort to prevent reintroduction of the disease, in conditions in which – although imported cases may continue to be reported – local malaria cases are no longer registered. The aims of the malaria elimination programme are therefore twofold:

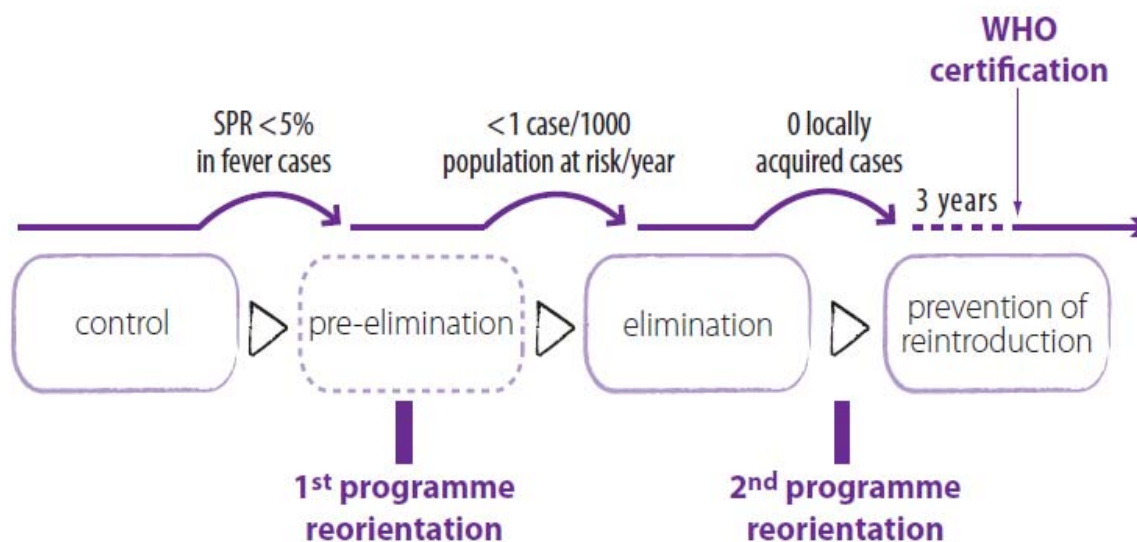
- complete interruption of malaria transmission in the country and the absence of locally acquired malaria cases, with adequate and effective malaria surveillance activities throughout the entire country; and
- national health and surveillance systems that are able, in cases of renewed transmission of malaria, to detect all malaria cases, determine their causes and respond to them rapidly and effectively.

Figure 1 illustrates the phases of the malaria programme and the thresholds for each new stage in the continuum control – pre-elimination – elimination – prevention of reintroduction.

Countries that have become malaria-free face the challenge of developing a national programme to prevent the reintroduction of malaria transmission. The transition from malaria elimination to prevention of reintroduction is possible only when adequate and effective surveillance of the disease in the country has proved that malaria transmission has been interrupted, that there are no cases of malaria due to local transmission anywhere in the country and that all reported cases of malaria are imported.

The programme to prevent the reintroduction of malaria in the country should continue until the goal of malaria eradication – defined as complete interruption of transmission of all forms of human malaria throughout the world – is achieved.

Figure 1. Malaria programme phases and milestones on the path to malaria elimination^a



SPR: slide or rapid diagnostic test positivity rate.

^a These milestones are indicative only; in practice, the transitions will depend on the malaria burden that a programme can realistically handle (including case notification, case investigation, etc.).

Importation of malaria and its consequences

The arrival in a country or area of persons infected with malaria parasites is defined as malaria importation; it has become a common phenomenon in recent decades as a result of easier and more frequent international travel. The role of immigrants and refugees in malaria importation has also grown in significance.

Importation of malaria cases should be distinguished from importation of infected mosquitoes, when malaria parasites are brought into an area by mosquitoes that either fly across the border or are passively transported, usually by aircraft. Migration of mosquitoes from Afghanistan is believed to have played an important role in sustaining the transmission of malaria in southern Tajikistan between the 1960s and the 1980s, when the disease had been eliminated in most parts of the country. The importation of infected mosquitoes by aircraft is reported in some European countries and is often referred to as “airport malaria”.

The consequences of malaria importation can be categorized as:

- clinical (morbidity, mortality and disability)
- epidemiological (introduced and indigenous cases)
- economic (factors such as the loss of labour and the cost of malaria control activities).

The consequences of importation of falciparum malaria are largely clinical because mosquito vectors in the European Region are rarely if ever infected by *Plasmodium falciparum* parasites brought from other parts of the world. However, there may also be epidemiological consequences if *P. falciparum* malaria is imported from neighbouring regions (for example, from Afghanistan to the south of central Asia), as demonstrated in Tajikistan. By contrast, the consequences of importation of *P. vivax* malaria are primarily epidemiological.

Prevention of malaria importation depends mainly on the prevention of malaria infection and disease among people travelling to, or arriving from, malaria-affected areas. While it is not always possible to identify all infected persons crossing a border, preventing the consequences of imported malaria is quite feasible. The key elements of such prevention remain early detection and treatment of malaria among immigrants and travellers.

The main approaches and activities for preventing malaria importation and its consequences are described in the paragraphs that follow.

Prevention of malaria importation into the country

Activities to prevent malaria importation are aimed at preventing infection and disease among people travelling to or arriving/returning from malaria-endemic countries. In some cases, adequate and efficient surveillance of such groups is possible. For example, effective monitoring of organized groups of specialists, students, workers and tourists can be carried out by student health centres and health centres that provide care to migrant workers and by extending and clarifying the health care obligations of bodies such as tour operators and employers.

Prevention of consequences of malaria importation into the country

The main activities for preventing the consequences of malaria importation are: early detection, effective treatment, good laboratory control and detailed epidemiological investigation of malaria cases among immigrants, students, travellers and similar groups – both local residents returning home and residents of malaria-endemic areas arriving in the country.

Prevention of malaria importation as a result of active mosquito migration from other countries

Activities to prevent malaria importation by active mosquito migration should be carried out in areas bordering countries where malaria occurs regularly or occasionally. They should be aimed at protecting the local population; coordination of activities with similar services in the neighbouring countries is essential.

Prevention of passive malaria importation into the country

The term passive malaria importation refers to malaria parasites brought into an area by infected mosquitoes that are passively transported, usually by aircraft. Key activities in this area should focus on airports and land border crossing points and should be coordinated with the special services at the borders (such as sanitary and quarantine stations and transport control centres).

The risk of malaria reintroduction and associated factors

The combined effect of receptivity and vulnerability, and thus the risk of reintroduction of malaria in a country, depends on numerous ecological, climatic, socio-demographic,

epidemiological, entomological and other factors. Assessment of the risk, of its components and of the relationships between them is thus of immense importance for the health services and forms the basis for the development of strategic and practical plans to prevent malaria reintroduction in the country.

Receptivity to malaria transmission depends on the presence of local vectors and the existence of environmental and climatic conditions favourable to malaria transmission. The major factors that determine receptivity are the abundance of local vectors and their ecological requirements, the degree of anthropophily, the life expectancy of mosquitoes, and the duration of parasite development in the mosquito in the particular climatic conditions of the area. Vulnerability is defined as the degree of probability of malaria parasite importation into a country or area.

Receptivity and vulnerability are poorly correlated: receptivity characterizes the possibility of onward transmission of malaria in the country after elimination of the disease, whereas vulnerability characterizes the risk of introduction of malaria parasites into an area where they do not exist. The juxtaposition of these two factors, however, makes it possible to estimate the risk of malaria reintroduction and to simulate possible scenarios. It should be remembered that, if the value of one factor is zero (even when the value of the other is high), the possibility of malaria reintroduction is also zero. Table 1 shows how the risk of malaria reintroduction is assessed.

In all cases, assessment of the risk of malaria reintroduction should be based on a detailed analysis of the risk factors across the country and stratification of the country according to the results of the assessment.

Table 1. Assessment of the risk of malaria reintroduction

Scenario	Risk assessment factors		Risk of malaria reintroduction
	Receptivity	Vulnerability	
1	+	+	From high to low, depending on the severity of risk factors
2	+	–	None (can rise with increasing degree of vulnerability)
3	–	+	None (can rise with increasing degree of receptivity)
4	–	–	None

Regional framework for prevention of malaria reintroduction

Moving into a new period, characterized by the absence of local malaria cases, requires the development of a national programme for prevention of malaria reintroduction. Experience gained during the malaria elimination period should be used as a basis for the development and implementation of a new programme and a set of activities aimed at preventing the re-establishment of malaria transmission. The goals, aims, objects of intervention, conditions required for the programme implementation and the main elements of the programme are described below.

Goal of the framework

The goal of the framework is to maintain the malaria-free status of an area or country by preventing the occurrence of introduced cases (epidemiologically linked to imported cases) and of indigenous cases (secondary to introduced cases).

Objectives of the framework

The objectives of the framework are:

- early detection and notification of all malaria cases and prompt diagnosis and treatment;
- determination of the probable causes of the reintroduction of malaria transmission;
- immediate action in the event of renewed local malaria transmission;
- determination of the risk of malaria reintroduction on the basis of assessment and regular monitoring of receptivity and vulnerability of the area.

Objects of intervention

The objects of intervention are imported and introduced cases of malaria, as well as indigenous cases secondary to introduced cases.

Main approaches and activities for preventing malaria reintroduction

The government should give priority to the programme based on this framework, allocating adequate funds for its implementation and assuming a number of obligations for the entire duration of the programme. These obligations relate not only to ensuring the presence of the necessary personnel and logistic and financial resources but also to the administration, organization and management of the programme. The programme must be approved by all stakeholders.

Development of the programme should emphasize the system of early notification of all cases of imported and locally acquired (introduced and indigenous) malaria. The surveillance system for malaria should be effective, should operate throughout the country (regardless of the level of risk) and should be able to promptly detect and report all cases of renewed malaria transmission. All malaria cases should be investigated and the information collected should be stored in the national register of malaria cases.

The general health care system must be able to detect and treat all reported cases of malaria. Particular attention should be paid to laboratory services and to quality control of their work. An adequate entomological surveillance system, operating throughout the country, should be able to monitor populations of *Anopheles* mosquitoes and evaluate the effectiveness and quality of vector control activities.

Training and retraining of epidemiologists, parasitologists, entomologists, general physicians, nurses and laboratory personnel on malaria-related issues should also remain a priority. Training in malaria can be included in graduate and postgraduate education. Particular attention should be given to maintaining malaria awareness among the population, such as through various educational programmes. A unified national database should be created for the continuous collection, processing, analysis and exchange of information on malaria. Applied research should focus on the identification of risk factors for malaria reintroduction.

Implementation of the programme should be monitored periodically on the basis of national indicators, and its performance and results should be assessed annually. The programme should include cross-border and intersectoral cooperation, as well as collaboration with WHO and other international organizations, so as to coordinate efforts for the prevention of malaria reintroduction into the country and beyond its borders.

The programme should specify not only the goals, objectives and key strategic approaches, but also a set of specific activities to be implemented; the choice of activities should be based on assessment of the local situation and levels of receptivity and vulnerability of the area. Two examples of possible situations are provided in Tables 2 and 3 for illustration. In areas where both indicators are low, the main focus should be on early detection of malaria cases by general health care workers who need to be vigilant for the disease and the possible reintroduction of its local transmission. Prevention of malaria reintroduction can often be ensured by epidemiological investigation of all confirmed imported cases of malaria, together with immediate and effective health care interventions.

When the receptivity and vulnerability of the area increase, the measures described must be supplemented by active detection of malaria cases, for example through door-to-door visits. In areas of high vulnerability, it is possible – even essential – to implement malaria vector control measures to reduce receptivity. In addition, the vulnerability of an area may be reduced by ensuring access to malaria diagnosis and treatment for the entire population, including immigrants and refugees. In some areas, especially those with a high influx of immigrants from malaria-endemic countries, screening high-risk populations for malaria infection may be recommended.

Table 2. Recommended curative and preventive measures for different risks of malaria reintroduction

High receptivity and vulnerability	Low receptivity and vulnerability
<ul style="list-style-type: none"> ● Passive case detection.^a ● Active case detection^b during the transmission season. Normally, active case detection activities are conducted every 14 days. They are performed more often, however, in cases of renewed local malaria transmission related to imported cases or to massive importation of malaria by migrant groups. ● Hospitalization of patients. ● Epidemiological investigation of all cases of malaria. ● Treatment of all confirmed cases of malaria: <ul style="list-style-type: none"> – treatment with blood schizonticidal drugs; – radical treatment of <i>P. vivax</i> malaria, concurrently with administration of blood schizonticidal drugs; – gametocidal treatment of imported cases of <i>P. falciparum</i> malaria during the transmission season; – special attention should be given to suspected <i>P. falciparum</i> malaria cases, especially severe cases. 	<ul style="list-style-type: none"> ● Passive case detection. ● Hospitalization of patients. ● Epidemiological investigation and epidemiological classification of all cases and foci of malaria. ● Treatment of all confirmed malaria cases: <ul style="list-style-type: none"> – use of schizonticidal drugs; – radical treatment of <i>P. vivax</i> malaria, concurrently with administration of blood schizonticidal drugs; – special attention should be given to suspected <i>P. falciparum</i> malaria cases, especially severe cases.

^a Detection of malaria cases among patients attending a health facility for diagnosis and treatment, usually for febrile disease.

^b Detection by health workers of malaria infections at community and household level. Active case detection can be conducted as fever screening followed by parasitological examination of all febrile patients or as parasitological examination of the target population without prior fever screening.

Table 3. Recommended set of vector control measures for different risks of malaria reintroduction

High receptivity and vulnerability	Low receptivity and vulnerability
<ul style="list-style-type: none"> ● Environmental management aimed at sustained improvement of areas and rational planning of hydro-engineering and drainage projects. ● Introduction of <i>Gambusia</i> fish into all sites where <i>Anopheles</i> mosquitoes breed. ● Other activities against <i>Anopheles</i> larvae can also be applied, but only in breeding sites where the effectiveness of introduction of <i>Gambusia</i> is reduced by overgrown vegetation. ● Indoor residual spraying should be carried out only in exceptional cases, such as when there is extensive importation of malaria by refugees or agricultural workers, or when infected mosquitoes invade the border areas. 	<ul style="list-style-type: none"> ● Vector control activities are carried out as part of the general mosquito management programme.

The following activities are recommended for detection, diagnosis and treatment of malaria cases.

- There should be early and mandatory reporting of all confirmed and suspected malaria cases identified by public and private health care institutions to a special national medical institution under

the ministry of health (for example, the national epidemiological service) responsible for preventing malaria reintroduction. All identified malaria cases should also be recorded in the national register.

- Notification can be by telephone, fax or e-mail. It is advisable that a free hotline be established so that everyone can get the necessary information related to the diagnosis, treatment and prevention of malaria. If one is not already available, a standard electronic form should be developed for notification of all malaria cases; this should be posted on the website of the health institution mentioned above and be accessible to all those who are responsible for the detection, diagnosis and treatment of malaria in the public and private health sectors.
- It is essential to ensure that all confirmed and suspected malaria cases in the private sector are referred to public health institutions for confirmation of diagnosis and appropriate treatment.
- Diagnosis and treatment of malaria should be free. Particular attention should be paid to strengthening the parasitological laboratories of public health facilities, which should receive and analyse blood samples from all malaria patients to confirm the final diagnosis. All forms of malaria should be treated in the public health sector. National policies and recommendations for the treatment of malaria should be updated periodically.
- At points of entry, immigrants from malaria-endemic countries should be provided with printed materials on malaria, including information about what to do in case of suspected malaria.
- People travelling to malaria-endemic countries should be made fully aware of the means of preventing the disease. If possible, malaria prevention interventions should be free. Every year, ministries of health should provide the epidemiological and health care services in the country with WHO information on drug-resistant malaria in different countries and areas of the world, and with recommendations for antimalarial drugs, including the schemes and doses to be used.
- When a local malaria case has been identified, the public health agency or institution responsible for prevention of malaria in the country should conduct an epidemiological investigation of both the case and the malaria focus.

The availability in the country of mechanisms for responding to emergencies (such as floods, social instability and mass migration), which may cause a malaria outbreak, will help in the provision of rapid and adequate measures to detect cases and contain outbreaks. It is imperative that malaria-free countries have mechanisms for prevention, forecasting and early detection of, and rapid response to, emergency situations related to malaria. National emergency plans should be based on the most likely scenarios and should take all risk factors into account. They should contain information about resources that can be quickly mobilized and channels that can be employed for the effective provision and use of these resources.

In cases of malaria parasites being brought into the area by infected mosquitoes that have been passively transported, usually by aircraft, spraying of vehicles or aircraft with insecticides may be recommended (in accordance with the current International Health Regulations).

Where there is a risk of the importation and reintroduction of malaria, there should be particular emphasis on the training of national health workers in malaria-related issues. In addition to the training, and retraining, of specialized health professionals, special attention should also be paid to improving the knowledge and skills of general medical staff in the diagnosis, treatment and

prevention of malaria, malaria surveillance and community-based activities. Training of laboratory staff is also important and should include basic training, refresher courses and regular supervision.

In the prevention of reintroduction phase, greater attention should be given to public involvement and partnerships between civil society groups and public health services. Malaria prevention activities should be implemented in close liaison with the population: even the best preventive strategy will fail if the public is unaware of the benefits of disease prevention.

Entomological monitoring of malaria vectors should be continued when a country or area is in the phase of maintaining its malaria-free status and preventing malaria reintroduction. The entomological services should closely monitor vector breeding sites by estimating the abundance of larvae and adult mosquitoes both indoors and outdoors, monitoring resistance to insecticides, and monitoring such meteorological indicators as the average daily temperature and rainfall.

Vector control can be recommended, particularly in border areas. Vector control activities should be chosen on the basis of local environmental, epidemiological, social and economic conditions, and their implementation should be coordinated with other sectors, local authorities and relevant services in neighbouring countries.

Environmental management activities can also be considered for preventing the breeding of *Anopheles* mosquitoes and renewed malaria transmission. Provided that they are carried out promptly and professionally, their results are long-lasting. Moreover, they do not require the purchase of special equipment: conventional construction equipment can be successfully used for this purpose.

All current and potential *Anopheles* breeding sites should be covered by environmental management activities. The objects of these activities thus include almost all types of surface water.

Filling unnecessary water reservoirs with soil is the most radical hydro-engineering procedure, as it completely eliminates mosquito breeding sites and will not require any maintenance.

During the process of transpiration, plants emit considerable amounts of water absorbed from the soil. The planting of rapidly transpiring vegetation thus helps to lower the groundwater level and eliminate waterlogged areas. A particularly significant effect is observed with such plants as eucalyptus and sunflower, although the use of eucalyptus can be recommended only for the southernmost countries of the Region.

For crops to be grown successfully, groundwater should be at a certain level relative to the soil surface. To maintain this level, it is often necessary to create a network of drainage channels – either open ditches or closed drains. This drainage system should be well maintained to avoid inadvertent creation of mosquito breeding sites.

Construction of water reservoirs requires prediction of resulting changes in the malaria situation in the affected area. Only a specialist with excellent knowledge of local ecology and vector biology will be able to forecast how the size and location of *Anopheles* breeding sites will be affected once the artificial reservoir is filled with water. Particular attention should be paid to location of the planned dam and to the normal headwater level. Even when a dam is ideally sited

and constructed, there can be no guarantee of the complete absence of *Anopheles* breeding sites in the reservoir.

Methods of eliminating *Anopheles* breeding sites may thus include:

- installation of dykes around reservoirs to protect the surrounding area from flooding;
- drainage of groundwater in agricultural areas by means of well-maintained open and/or closed drainage systems;
- planting of rapidly transpiring vegetation to help lower the groundwater level and eliminate waterlogged areas;
- levelling of the soil surface in waterlogged areas to prevent puddles from forming;
- deepening of shallow areas.

The creation of large reservoirs often entails relocating people who live in the area to be flooded in new settlements along the banks of the future reservoir. Rational location of these settlements will help to reduce human contact with malaria vectors and the risk of malaria.

The introduction of larvivorous fish may be recommended in some cases. This is a simple procedure, involving significant expenditure only in the early stages. Specialists planning to use such fish should assess the possibility and advisability of using this approach in different types of reservoir.

Attention should also be paid to the following approaches:

- monitoring the condition of water sources and preventing the creation of stagnant water pools near them; some *Anopheles* species – *An. claviger*, *An. plumbeus* – can breed in artificial ponds with solid walls, such as water wells, water tanks and cisterns, which should therefore be fitted with tightly closing lids;
- controlling the accumulation of water within settlements and round houses/compounds (removal of vegetation, deepening of shallow water reservoirs, straightening and strengthening of the banks of ponds and other artificial water reservoirs);
- eliminating small ponds and puddles in areas adjacent to human settlements;
- preventing the growing of rice on private plots within the boundaries of settlements or homesteads.

To prevent the return of malaria to malaria-free areas once vector control activities have been radically reduced, methods of individual and collective protection of the population should be emphasized and promoted. The following approaches can be used to protect people from mosquito bites:

- physical barriers, such as mosquito nets and screens and protective clothing, which protect people from mosquito attacks and, if they are impregnated with insecticides, serve to regulate mosquito populations;
- use of insect repellents to make people unattractive to mosquitoes as blood-meal hosts;

- “distracting” mosquitoes from attacking people; in livestock farming areas, for example, livestock have long been used to form a zoological barrier, distracting mosquitoes and thus protecting people from contracting malaria and other vector-borne diseases.

Certification of malaria elimination

Background

The global malaria eradication programme, coordinated and supported by WHO between 1957 and 1972, was successful in most temperate countries but did not achieve its objectives in tropical regions.

In 1959, the WHO European Regional Committee urged Member States in which indigenous malaria was a public health problem to reach the consolidation phase in their respective eradication programmes within the following three years. By 1963, this objective had been achieved and, over the next decade, most countries in the Region fulfilled the criteria for malaria elimination. By 1975 it became clear that endemic malaria had disappeared from Europe for the first time in history, although the achievement of this goal had required far greater effort than was originally anticipated.

Successful elimination of malaria in Europe has demonstrated that large-scale vector control measures (particularly indoor residual spraying with insecticides) combined with adequate treatment and surveillance, are able to sharply reduce and even completely interrupt malaria transmission in areas with of relatively low-intensity transmission. In most European countries, the implementation of antimalaria activities, combined with modern agricultural methods, helped to reduce the risk of malaria reintroduction to very low levels. However, as WHO had stressed, any deterioration in public health services as a result of natural or social disasters could see the return of a broad range of infectious diseases, including malaria; this is what happened in the early 1990s, when the incidence of malaria began to rise in some countries of the Region.

Since 1956, when the WHO Expert Committee on Malaria first addressed the issue of malaria eradication, the main condition for the completion of the consolidation phase has been an adequate surveillance system, operating successfully and able to demonstrate unequivocally that malaria transmission has been interrupted throughout the country (or specific area) and that the local reservoir of malaria has disappeared. Malaria elimination was thus defined as a situation in which a high-quality surveillance system had revealed no evidence of malaria transmission – despite careful search for cases – during three consecutive years, in the absence of any malaria vector control measures in at least the previous two years. This functional definition was modified slightly and extended at later meetings of the WHO Expert Committee on Malaria.

Requirements and procedures for certification

Certification of malaria elimination is the official recognition of the achievement of malaria elimination in a specific country. It is granted by WHO when it has been proved, beyond reasonable doubt, that the chain of local malaria transmission by *Anopheles* mosquitoes has been fully interrupted throughout the country for at least three consecutive years.

The concept of certification of malaria elimination was first formulated by WHO at the start of the malaria eradication campaign of the 1950s and 1960s. Malaria eradication programmes consisted of four phases: preparatory, attack, consolidation and maintenance. Previous experience in eradication programmes showed that, during the advanced consolidation phase, and even later during the maintenance phase, isolated malaria cases are sometimes detected that cannot be classified as relapsing, induced, imported, introduced or locally transmitted. If an exhaustive epidemiological investigation failed to reveal the source of malarial infection, such cases were classified as “cryptic” and their presence was not considered to be incompatible with malaria eradication or an obstacle to the completion of the consolidation phase. Two further conditions, however, were to be met before a decision could be taken on bringing this phase to an end.

- First, it had to be proved that the surveillance had been adequate, that is, it was of high quality, based on active and passive case detection methods and appropriately supervised, that the laboratory investigations were reliable, prompt and efficient and that their results were accurate.
- Second, it had to be shown that preparatory work for initiating the maintenance phase had been completed.

Elimination of malaria, defined as interruption of local transmission of the disease throughout the country or area, does not require elimination of malaria vectors or the complete absence of malaria cases, since imported cases related to international travel may well be recorded.

Once an elimination programme has been successfully implemented, the government may be inclined to officially declare the elimination of malaria throughout the country. However, international recognition of such a declaration requires certification by WHO and subsequent inclusion of the country in an official register of areas where malaria elimination has been achieved. To achieve this, the government of the country must request WHO to undertake an inspection and review the achievements of the malaria programme. The inspection is carried out by an international team of independent experts acting on behalf of WHO. Upon completion of the various steps of the inspection and further review, the assessment report and recommendations are submitted to the Director-General of WHO whose final decision is communicated to the Member State concerned.

Currently, the process of certifying malaria elimination is based on the following principles:

- certification applies to a country as a whole and to all four human malaria species;
- inspection and evaluation are carried out by an expert team led by WHO; upon completion of the inspection, the expert team submits its report and recommendations to the Director-General of WHO;
- the final decision on certification is taken by the Director-General of WHO, and the Member State concerned is duly informed about this decision;
- registration of malaria elimination certification is published in WHO’s *Weekly Epidemiological Record*.

It remains the prerogative of a national government to decide whether to request certification of the achievement of malaria elimination in a country.

The process of certifying malaria elimination seeks answers to the following two questions, which are of great importance for both the country concerned and the international community:

- Has indigenous transmission of malaria been durably interrupted throughout the country?
- Can the country's existing health system (in particular the curative and preventive services and the epidemiological service) prevent the reintroduction of local malaria transmission?

Certification also confirms to the international community that the country has created an adequate system for preventing the reintroduction of local malaria. To maintain its malaria-free status, a country must show that it has the necessary political will and vision, has created the required legislative and regulatory framework and has adequate financial and administrative resources, personnel and technological capacity.

International recognition of the elimination of malaria in a country, based on the decision of the Director-General of WHO, is recorded in both *Weekly Epidemiological Record* and *International Travel and Health*.

The malaria-free status of a country provides direct and indirect economic benefits in such areas as tourism, business and student exchange programmes. Thus, the political, social and economic importance to a country of eliminating malaria, and of certification of this status, cannot be overestimated.

Timeline and criteria for certification

When interruption of malaria transmission is achieved throughout a country and the absence of local malaria transmission has been maintained for at least three consecutive years, the country may request WHO to begin the process of certifying its territory as malaria-free.

A country asking WHO to certify its malaria-free status must submit the necessary evidence that local transmission of malaria has been absent for at least three consecutive years and that the country has an efficient system for epidemiological surveillance of malaria which is able to detect any signs of possible malaria transmission. Certification of malaria confirms both that local malaria transmission has been interrupted throughout the country and that the country has an effective system of epidemiological surveillance of malaria.

WHO can reach a decision about the absence of malaria cases and the interruption of local malaria transmission only when the country has demonstrated that it has:

- a high-quality system of malaria surveillance covering all areas of the country;
- a national register of malaria cases and a system of emergency alert and prompt notification of all cases of malaria by the public and private health sectors;
- an adequate system for early detection and effective treatment of imported malaria cases and for their subsequent clinical and epidemiological monitoring;
- laboratory services that provide high-quality and prompt parasitological diagnosis of malaria throughout the country, including the most remote and inaccessible areas;
- a system that ensures prompt and thorough epidemiological investigation of each case of malaria;

- a national plan of action aimed at preventing the reintroduction of local malaria transmission in the country, financed by the national budget and supported by the national government.

To prevent the reintroduction of malaria and maintain the favourable epidemiological situation the country should also have:

- an adequate system for early recognition and rapid response to malaria outbreaks;
- an effective mechanism for coordinating preventive measures in areas bordering neighbouring countries (if necessary);
- an effective mechanism for intersectoral cooperation among all ministries and agencies involved in the prevention of malaria;
- a high-quality system of entomological surveillance, including monitoring of resistance of malaria vectors to insecticides, especially in areas with high receptivity;
- a centralized computerized database of malaria cases and malaria foci, with a geographic information system for mapping;
- an adequate system of prevention and health education that helps to identify promptly all cases of imported malaria and to eliminate the risk of reintroduction of local malaria transmission; this system should include the development and distribution of recommendations for the prevention of malaria among people travelling to or returning from malaria-endemic countries.

Special studies may provide additional proof that malaria transmission has been interrupted. For instance, molecular epidemiological studies using polymerase chain reaction-based techniques have shown an absence of malaria parasites over a number of countries in the Region.

Stages of the certification process

The process of certifying a country as malaria-free, from the country's request to WHO through to publication of the certification decision in the *Weekly Epidemiological Record*, includes the steps outlined below.

Request to start the certification process

As a first step, the minister of health, on behalf of the government, must send an official letter to the Director-General of WHO and the Regional Director with a request for the process of certification of malaria elimination to be started in his or her country. The Director-General notifies the country that WHO has received this request and, if the decision is favourable, that the Organization agrees to start the certification process and is prepared to afford the country the necessary scientific, methodological and consultative assistance through the malaria programme at both WHO headquarters and the Regional Office. The Director-General also informs the country about the certification process, the associated criteria and the required documentary evidence that malaria transmission has been interrupted throughout the country.

Establishment of the national certification committee and its activities

The country creates a national certification committee which is responsible for the preparations for certification and for subsequent work with WHO. The government approves the composition, scope and work plan of the national certification committee, including the timeline of activities.

Preparation of documents recommended by WHO for the certification process

The country prepares the documents required for certification, which must be submitted to WHO to confirm that interruption of local transmission of malaria has been achieved throughout the country. The list of the necessary documents is as follows:

- a national action plan aimed at prevention of reintroduction of malaria;
- an organizational structure of the malaria control programme and the plan of its activities at all levels, including details of the budget and of the personnel involved;
- annual reports on malaria surveillance in the previous 10 years;
- a complete database of all malaria foci, with detailed maps, for the last five years, including the date of registration of the last local malaria case;
- a national register of malaria cases and foci, with maps of epidemiological investigations of cases identified in the previous five years;
- reports on the monitoring of the quality of malaria diagnosis;
- existing national policies and recommendations for the treatment of malaria;
- reports on the entomological situation and activities aimed at malaria vector control;
- reports of the national committee for malaria elimination responsible for the overall coordination and monitoring of the activities;
- recent scientific publications on epidemiology, control and elimination of malaria and malaria vectors in the country;
- all existing legal frameworks and administrative acts related to malaria control;
- reports on community-based activities related to the prevention of malaria;
- reports on intersectoral cooperation for malaria control;
- reports on cross-border cooperation with neighbouring countries for malaria control and elimination.

Preparation of a national report on the elimination of malaria in the country

A national report on the elimination of malaria is prepared by the country for consideration by WHO and a group of independent experts. This document is critical and requires careful preparation.

Visit by WHO certification team and a group of independent experts

Typically, as a first step, WHO sends its specialists to the country to assess whether the certification criteria have been met. Members of the WHO certification team examine the prepared documents, including the national report, collaborate with the national certification committee and visit previously endemic areas, curative and preventive health institutions and relevant ministries and departments. On the basis of the material collected, the WHO team prepares its comments and suggestions for the country, and decides whether the country is ready for certification and whether sending an independent expert group to the country is warranted.

The group of independent experts carefully studies all documents, including the national report, thoroughly reviews current and past activities, visits previously endemic and non-endemic malaria areas, reviews the activities of relevant departments and agencies and meets the relevant decision-makers. Finally, the group addresses the two main questions, namely, whether malaria has been eliminated in the country, and whether the country has an effective health system that is able to prevent malaria reintroduction. The group then submits its conclusions to the relevant department at WHO headquarters.

Final evaluation by the WHO Expert Committee

The relevant WHO department transmits all the evaluations prepared by the certification team and reviewed by the group of independent experts, including conclusions, recommendations and other necessary documents, to the WHO Expert Committee on Malaria. If necessary, the Committee, through its chairperson, may contact the relevant ministry of health directly for further information. Once the Expert Committee members have completed their deliberations, the chairperson informs the Director-General of the Committee's decision.

Final decision

The Director-General of WHO makes the final decision on granting malaria-free status and communicates this decision in an official letter to the national government.

Publication of information about the certification

When a country is granted certification of its malaria-free status, the WHO secretariat publishes the fact in the *Weekly Epidemiological Record*, and the country is included in the WHO Official Register of areas where malaria elimination has been achieved.

Post-certification period

After certification of malaria elimination, the country must continue its efforts to prevent the reintroduction of local malaria transmission as well as to collect and provide relevant information on malaria to the relevant Regional Office on an annual basis.

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**The WHO Regional
Office for Europe**

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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