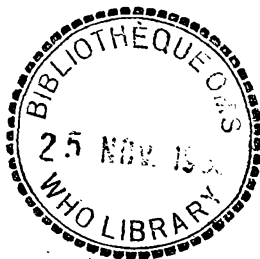


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SOME ASPECTS OF THE PROBLEM OF IMPORTED MALARIA
IN MALARIA ERADICATION PROGRAMMES

by

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1. Introduction

The importation of malaria from one country into another by human beings or mosquitos can be assumed to go on continuously. It occurs also in countries carrying out malaria eradication programmes. While a country has a great deal of "its own" malaria, the importation of the disease from other countries is often ignored. For the time being, all malaria eradication measures are planned without taking into account the influx of the causative agent from outside. Usually also, the local malaria is defeated despite the continuing influx of "other people's" malaria. Only in exceptional circumstances, when the extent of imported malaria is very great, can it contribute towards a delay in malaria eradication. One example is given by the north-western states of Venezuela (Tachira, etc.) where the eradication of local malaria cannot be successfully brought to a conclusion, despite the most energetic efforts, because of a huge influx of seasonal workers from districts with a high incidence of malaria in neighbouring Colombia. Apparently the delay in the complete eradication of malaria in the southern regions of Tadzhikistan can also be ascribed to mosquitos constantly bringing in the disease from Afghanistan

Discounting such rare cases, the measures carried out in the attack and consolidation phases to eradicate local malaria are sufficient to ensure the necessary interruption in transmission, and cases of imported malaria remain epidemiologically

insignificant. The position changes radically in the maintenance phase, when the mosquito population is recovering and surveillance operations are reduced to a minimum. Under these conditions, the continuing influx of imported malaria may lead to serious consequences.

2. Possible consequences of the importation of malaria

The importation of malaria, depending on the circumstances obtaining during the maintenance phase, may lead to consequences of three types:

- (a) new active malaria foci may arise on a territory previously cleared;
- (b) the incoming malaria patients will not become sources of infection but serious damage may be done to their health because of delay in establishing the correct diagnosis and giving appropriate treatment;
- (c) cases of post-transfusion malaria will occur if an unrecognized parasite carrier is used as a blood donor.

Obviously the most important consequence is that mentioned under (a). For that reason, it is important to have some idea of the factors that determine the different degrees of risk from imported malaria.

3. Factors affecting the risk from imported malaria

It was quite correctly emphasized in the report of the Palermo Conference on Malaria Eradication (1960) that "in countries where eradication has been secured as a result of a campaign deliberately organized and carried through, the approach to the control of immigrants liable to be malaria carriers should be different from that in countries where the disease has disappeared without intervention on the part of man".

However, this proposition must now be made more precise. Allowance must be made for the fact that in many countries in the first group, essential changes occur in natural and social conditions in the course of malaria eradication, which prevent potential endemicity reaching the level existing before the beginning of the eradication programme. Some of the changes of this nature that have occurred during the last 10-15 years according to observations in the USSR and in some other countries are as follows:

- (a) huge districts with large swampy areas of breeding places for malaria vectors - which were formerly untilled, have been drained, settled and used for market-gardening, orchards and field crops (USSR, Bulgaria, Albania, Israel) or turned into holiday areas (Georgian SSR, Bulgaria);
- (b) the old ditch systems of irrigation which led to the formation of numerous bodies of water in which Anopheles could breed have given way to a new system with a controlled water supply and with no bodies of water left to stagnate for long (Tadzhik SSR, Uzbek SSR);
- (c) the population from narrow mountain valleys, formerly highly infested with mosquitos, has moved to the wide valleys, the land in which is used entirely for crops. The mountain valleys are being transformed into rest areas, in which protection against mosquito bites is provided by insecticide spraying (Tadzhik SSR);
- (d) over huge areas under cultivation a campaign against plant pests is being waged with the help of insecticides that also destroy mosquito larvae in their breeding places and adult mosquitos resting upon vegetation (USSR);
- (e) many collective and State farms regularly and extensively spray premises in their areas with insecticides with a view to controlling ticks or various blood-sucking Diptera (USSR);
- (f) the health authorities are continuing to spray premises with insecticides in former malarious areas with a view to controlling leishmaniasis (Turkmenia, Uzbekistan), tick-borne spirochaetosis (Uzbekistan, Tadzhikistan) and Chagas' disease (Venezuela).

All these measures, and others like them, have a tremendous, though indirect, effect, on the Anopheles population. Cases in which the mosquito population can swiftly recover to its initial level after cessation of antimalarial spraying have become, according to Soviet observations, the exception rather than the rule.

In many former malarious areas, important changes in the medical services available to the inhabitants, the number of domestic animals kept by the population, improvements in housing conditions and in the level of health consciousness of the population, etc. occur simultaneously with the eradication of malaria.

All this taken together has a considerable effect on the conditions in which imported malaria can establish itself. In districts with an initially high endemic level but in which substantial changes have occurred in natural and social conditions, the chances of imported malaria becoming established are no greater than in districts where the endemic level was formerly low but in which no essential changes have occurred during malaria eradication.

Consequently, the risk of the re-establishment of imported malaria must be assessed primarily according to the place to which the parasite is imported, i.e. according to the past endemic level and the nature and extent of changes that have occurred in the course, and after completion, of malaria eradication in each locality.

A second group of factors depends on the place from which malaria is imported. It is hardly possible to equate the importation of malaria from countries situated in the same zoogeographical region as the "importer" country and its introduction from some other zoogeographical region. It is quite probable that in countries, such as the European-Siberian Palaearctic sub-region, the introduction of malaria parasites from countries in the Mediterranean sub-region is more dangerous than from African countries belonging to the Ethiopian region. It seems probable that the marked predominance in the Ethiopian region of Plasmodium falciparum over Plasmodium vivax and the low rate of infectivity of Palaearctic mosquitos with tropical strains of Plasmodium falciparum should diminish the risk of malaria imported from the countries of tropical Africa becoming established in Europe.

Of course, it is just as important also to find out what measures of malaria control are being carried out in the country or zone from which malaria has been introduced.

A third group of factors depends on by whom and how malaria is imported. It has already been indicated (Swellengrebel, 1960; Costa, 1960; Gramiccia, 1962; Panos, 1962; Sautet, 1962) that the probability of a parasite carrier being present differs among different groups of incoming people. It seems to us that persons entering the country should also be considered in relation to the probability of the parasite carrier becoming a source of infection, which would depend on the conditions in which he lives after his arrival. Table 1 and 2 summarize some of the data accumulated in the Soviet Union.

Finally the danger of malaria being imported into countries where the disease is seasonal will to a certain degree, depend also on when the possible parasite carriers arrived (during the possible transmission season or outside it). Thus in assessing the risk of malaria being imported and devising methods of preventing its consequences, a country must take fully into account whence, whither, by whom, how and when importation of malaria occurred.

4. Preventive measures

It will probably be useful to distinguish between measures to prevent the importation of malaria and measures to prevent consequences arising from importation that has certainly or probably taken place. In addition, a distinction should be drawn between measures affecting nationals of the country concerned returning from journeys abroad and foreigners, as indicated in Table 3.

The overwhelming majority of the necessary measures can be taken by each country separately, without international agreement. The only thing that should possibly be made clear in the International Sanitary Regulations is the position in regard to the compulsory nature of investigation for malaria and, if necessary, the subjection to chemoprophylaxis or radical treatment of all persons arriving from countries where malaria is endemic and proceeding to rural areas of the country concerned in which there is a high level of potential endemicity.

Of course, a list of localities in each country belonging to the category of areas with a potentially high level of endemic malaria should be notified through WHO to other countries and brought to the notice of persons travelling to these localities. The suggestion made by Gramiccia (1962) that a list of countries and districts where malaria transmission is still taking place should be published periodically is also to be welcomed.

Conclusions

1. Measures aimed at preventing the introduction of malaria from abroad or preventing its consequences will differ not only between countries where malaria disappeared spontaneously and those where it was eradicated by planned efforts but also between countries and areas in which substantial changes in natural and social

conditions have taken place in the course of malaria eradication, changes that have reduced the potential endemic level to a minimum, and areas in which such changes have not taken place and potential endemicity tends to return to its initial level.

2. The importation of malaria into a territory where it was formerly eradicated may have three consequences: (a) the establishment of an active focus; (b) damage to the health of the malaria patients from abroad; and (c) the occurrence of cases of post-transfusion malaria (induced malaria).
3. In assessing the danger of importation of malaria and devising measures to avert its consequences, the malariologist should make a thorough analysis of whither, whence, by whom, how and when importation took place.
4. The carrying out of measures to prevent the importation of malaria parasites and its consequences does not require international agreement. It is desirable that every country interested in the prevention of the importation of malaria should inform other countries through WHO of areas where the anopheline population has largely recovered, the entry into which of foreigners who are potential parasite carriers may make it necessary to examine them for malaria and to prescribe chemoprophylaxis or radical treatment.

TABLE 1. THE IMPORTATION OF MALARIA PARASITES:
ROUTES AND DANGERS OF IMPORTATION BY HUMAN BEINGS

Incoming persons or groups	Probability of parasite carriers being present among the group concerned	Probability of the parasite carrier becoming a source of infection after arrival
<p>A. <u>Citizens of the country concerned who have visited another country in which malaria is endemic</u></p>		
<p>1. Those who have lived for a long period in a foreign country:</p> <p>(a) mainly in large cities (diplomats, university teachers, students and others)</p> <p>(b) in rural areas (road builders, agricultural specialists, etc.)</p>	<p>Not great</p> <p>Very great</p>	<p>Not great</p> <p>Very great</p>
<p>2. Persons who have been abroad for a short time:</p> <p>(a) tourist groups, delegations and missions</p> <p>(b) field expeditions (geographers, ethnographers)</p>	<p>Not great</p> <p>Considerable</p>	<p>Moderate</p> <p>Moderate</p>
<p>3. Crews of aircraft</p>	<p>Considerable</p>	<p>Very small</p>
<p>4. Crews of sea-going vessels:</p> <p>(a) passenger vessels</p> <p>(b) cargo ships</p> <p>(c) fishing vessels</p>	<p>Insignificant</p> <p>Considerable</p> <p>Considerable</p>	<p>Very small</p> <p>Very small</p> <p>Moderate</p>
<p>5. Crews of river vessels on frontier rivers</p>	<p>Great</p>	<p>Great</p>

TABLE 1. THE IMPORTATION OF MALARIA PARASITES:
ROUTES AND DANGERS OF IMPORTATION BY HUMAN BEINGS (continued)

Incoming persons or groups	Probability of parasite carriers being present among the group concerned	Probability of the parasite carrier becoming a source of infection after arrival
<p>B. <u>Citizens of another country where malaria is endemic</u></p>		
<p>1. Those coming for a long period:</p>		
<p>(a) mainly to large cities (diplomats, students, etc.)</p>	<p>Negligible among diplomats, considerable among students</p>	<p>Practically nil</p>
<p>(b) to rural areas (agricultural mechanization experts, livestock experts, etc.)</p>	<p>Great</p>	<p>Great</p>
<p>2. Persons coming for a short visit:</p>		
<p>(a) tourists</p>	<p>Differs according to the composition of the group</p>	<p>Very small</p>
<p>(b) members of delegations and missions</p>	<p>Differs according to the composition of the group</p>	<p>Very small</p>
<p>3. Crews of aircraft and ships</p>	<p>Considerable</p>	<p>Very small</p>
<p>4. Immigrants and repatriates</p>	<p>Great, particularly among rural dwellers</p>	<p>Great in the case of villages with high <u>Anopheles</u> population</p>

TABLE 2. IMPORTATION OF MALARIA PARASITES:
ROUTES AND DANGERS OF IMPORTATION BY MOSQUITOS

Route of entry of mosquitos from a country where malaria is endemic	Probability of infected mosquitos being present among those brought in	Probability of infection of local inhabitants
1. Free flight across the frontier.	Considerable	Considerable throughout the transmission season for inhabitants of the border zone who at night are not in premises sprayed with insecticides (frontier guards, persons sleeping in the open air, etc.)
2. Mosquitos brought in by strong wind	Considerable	Not excluded at the time of entry throughout the whole area where the mosquitos settle (see Garrett-Jones, 1961)
3. Mosquitos brought in on means of transport		
(a) aircraft	Negligible	Practically nil
(b) sea-going craft	Negligible	Practically nil
(c) small vessles on frontier rivers	Considerable	Small

TABLE 3. CLASSIFICATION OF VARIOUS MEASURES TO PREVENT THE IMPORTATION OF MALARIA PARASITES AND TO AVERT ITS CONSEQUENCES

	M e a s u r e s	
	in respect of the country's own nationals or on its own territory	in respect of foreigners
Prevention of importation	Chemoprophylaxis and other measures to prevent infection with malaria while they are staying in a malarious area in foreign countries (health education, the supply of instructional booklets and drugs, the provision of mosquito nets, the spraying of premises with insecticides, etc.)	Preventive radical treatment, before they leave known malarious areas, of persons proceeding to rural districts (immigrants, repatriates, students, etc., organized groups)
Averting the consequences of importation of malaria that has already taken place	<p>A. <u>Measures in regard to potential parasite carriers</u></p> <p>1. Case detection and detection of parasite carriers:</p> <p>(a) registration of persons leaving for countries where malaria is endemic;</p> <p>(b) the classification of the persons registered according to degree of risk of infection;</p> <p>(c) examination of those returning and observation of the persons most likely to be carriers</p>	<p>1. Case detection and the detection of parasite carriers:</p> <p>(a) examination of the blood for malaria in all persons arriving from countries where malaria is endemic who have sought medical advice;</p> <p>(b) mass examination of organized groups coming from countries where malaria is endemic (students, etc.)</p>
Averting the consequences of importation of malaria that has already taken place	<p>2. Treatment of cases and parasite carriers discovered</p> <p>3. Mass chemoprophylaxis of groups of immigrants or repatriates settling in rural areas with a potentially high endemic level</p>	<p>2. Treatment of cases and parasite carriers discovered</p> <p>3. Mass radical treatment of groups found to have high rate of infectedness and who are entering rural districts with a potentially high endemic level during the possible transmission season</p>

TABLE 3. CLASSIFICATION OF VARIOUS MEASURES TO PREVENT THE IMPORTATION OF MALARIA PARASITES AND TO AVERT ITS CONSEQUENCES (continued)

M e a s u r e s	
in respect of the country's own nationals or on its own territory	in respect of foreigners
<p>B. <u>Measures in regard to the place of stay of potential parasite carriers</u></p> <p>1. Measures in centres of population where a case or parasite carrier has been discovered (they may differ, depending on the epidemiological condition of the village-focus (see Lysenko, 1962))</p> <p>2. Measures in other centres of population if indicated (see Lysenko, 1962)</p> <p>3. Measures to reduce the <u>Anopheles</u> population in places where there is a continuous mass influx of potential parasite carriers which is difficult to control (health resorts and holiday zones)</p>	<p>1. The insecticide spraying of living quarters in rural areas where affected groups are settling (or spraying of the whole village-focus)</p>

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