The role of vectors in emerging and re-emerging diseases in the Eastern Mediterranean Region

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دور النواقل في الأمراض المستجدة والمنبعثة في إقليم شرق المتوسط

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خلاصة وُجه في الآونة الأخيرة اهتمام عظيم على الصعيد العالمي إلى ما يُحدق بالبشر من أخطار وخيمة مبعثها الأمراض المُعدية الجديدة والمستجدة والمنبعثة من مرقدها . ومن الأمراض المُعدية المنقولة بالنواقل ، يعتبر الضنك (الدنج) وحمى الضنك النزفية والحمى الصفراء والطاعون والملاريا وداء الليشمانيات ، والفيروسات المحمولة بالقوارض والمحمولة بالمفصليات ، أمراضاً وكائنات مستمرة الوجود ، وإن كانت أحيانا تنبعث من مرقدها ، مسببة تهديدا خطيرا لصحة الإنسان . وأهم الأمراض المنقولة بالنواقل في إقليم شرق المتوسط هي حمى الضنك والملاريا وداء الليشمانيات . وتتناول هذه المقالة دور النواقل في انبعاث الملاريا وداء الليشمانيات وحمى الضنك ، كما تستعرض طرق مكافحة هذه الأمراض .

ABSTRACT Considerable attention has recently been drawn at a global level to the serious threat to humans by the new, emerging and re-emerging infectious diseases. Among the infectious vector-borne diseases, dengue, dengue haemorrhagic fever, yellow fever, plague, malaria, leishmaniasis, rodent-borne viruses and arboviruses are considered to be persisting, and sometimes re-emerging, with serious threats to human health. In the Eastern Mediterranean Region, dengue, malaria and leishmaniasis are the significant vector-borne diseases. This article discusses the role of vectors in the re-emergence of malaria, leishmaniasis and dengue fever and their control.

Le rôle des vecteurs dans les maladies émergentes et réémergentes dans la Région de la Méditerranée orientale

RESUME On a récemment, au niveau mondial, beaucoup attiré l'attention sur la grave menace que constituent pour l'être humain les maladies infectieuses nouvelles, émergentes et réémergentes. Parmi les maladies infectieuses à transmission vectorielle, on considère que la dengue, la dengue hémorragique, la fièvre jaune, la peste, le paludisme, la leishmaniose ainsi que les affections dues aux virus et arbovirus transmis par les rongeurs persistent et l'on observe quelquefois leur recrudescence, menaçant gravement la santé de l'être humain. Dans la Région de la Méditerranée orientale, la dengue, le paludisme et la leishmaniose représentent les maladies à transmission vectorielle importantes. Le présent article examine le rôle des vecteurs dans la réapparition du paludisme, de la leishmaniose et de la dengue ainsi que la lutte contre les vecteurs de maladies.

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Malaria

Malaria is the most important vector-borne disease in the Eastern Mediterranean Region. After a decrease in its incidence globally and in the Region in the late 1960s, an upward trend of malaria occurrence has been observed, caused by a number of technical and administrative factors. One of the most important factors is the increase in malaria vector mosquito densities due to decreased attention to vector control and leading to a consequent increase in the disease transmission.

In the Eastern Mediterranean Region, out of 70 species of anopheline mosquitos recorded, at least 18 are confirmed vectors of malaria (Figure 1). It is feared that, in addition to the possible intensification of the malaria problem in endemic countries, countries that are at present free from malaria may not be able to maintain their malaria-free status, if the required vector vigilance and control services and activities are not restored and maintained by these countries.

For the control of malaria vectors the global strategy of malaria control highlights the need for selective and sustainable control of vector mosquitos for the prevention of disease transmission and epidemics. The regional strategy on vector control emphasizes the integrated vector control approach, the use of insecticide impregnated bednets and other materials and preparedness for emergencies.

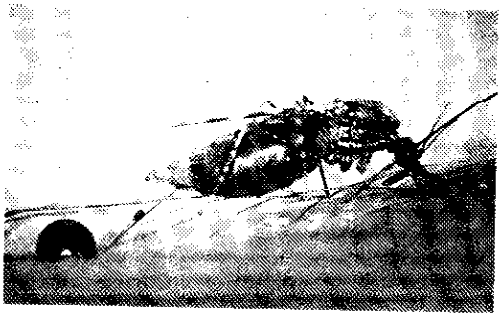

Figure 1 **Anopheles mosquito, vector of malaria**

Leishmaniasis

Leishmaniasis is another re-emerging vector-borne disease in the Eastern Mediterranean Region. The well known vectors are sandflies (Figure 2). They belong to the family *Phlebotominae*, which contains about 700 species, of which about 70 species are proven vectors of leishmaniasis. Of these, about 20 species have been found to play a significant role in transmission in Eastern Mediterranean countries. Two species *Phlebotomus papatasi* and *P. sergenti* are present in almost all countries of the Region. Visceral leishmaniasis (also known as kala-azar), zoonotic cutaneous leishmaniasis and anthroponotic cutaneous leishmaniasis are the three principal forms present in the Eastern Mediterranean Region. The disease is of serious public health concern in six countries and exists to a lesser degree in another 10 countries.

Leishmaniasis is considered to be a re-emerging disease globally and in the Eastern Mediterranean Region. During the past two decades, a rapid increase in incidence and geographical spread has taken place. For example, in the Syrian Arab Republic the number of cases of cutaneous leishmaniasis increased from 1650 in 1987 to 9000 in 1992; in Tunisia cutaneous leishmaniasis increased from 1300 cases in 1983 to 6000 in 1990. In Sudan the situation is very serious. During the past five years in southern Sudan, over 15 000 cases of kala-azar have been treated. During the same period, an epidemic built up in eastern Sudan, with the

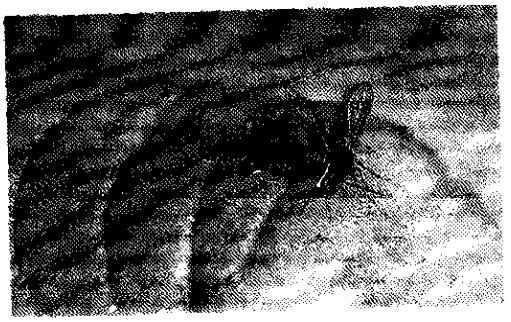

Figure 2 **Sandfly, vector of leishmaniasis**

number of cases increasing from 1100 in 1992 to over 2400 cases in 1993.

Among the factors responsible for this upsurge, the most important are rapid and unplanned urbanization, mass movements of people, congregation of human populations and implementation of water resource development projects (building dams and irrigation systems) without incorporating safeguards against disease vector proliferation. Also, phasing out of vector control activities such as residual spraying of insecticides for malaria and other vector control has contributed to the increase in vector proliferation.

Control of vectors of anthroponotic visceral and cutaneous leishmaniasis is carried out by indoor spraying with residual insecticides and the use of insecticide-impregnated bednets/curtains and other materials.

Control of zoonotic visceral leishmaniasis vectors is carried out by residual insecticide spraying of houses and animal shelters, especially where the vector sandflies are restricted to domestic and peridomestic areas. At the same time treatment or elimination of dogs, the main domestic reservoir of zoonotic visceral leishmaniasis, should be carried out. In the case of zoonotic cutaneous leishmaniasis, where rodents are the main reservoirs, the usual intervention is the application of rodenticides, destruction of rodent burrows and chenopod plants by deep ploughing. Rodent ectoparasites, such as fleas, are controlled by insecticidal application to rodent burrows before ploughing through them or application of rodenticides to kill rodents, especially in the vicinity of human inhabitations.

Dengue fever

Dengue fever, commonly known as breakbone fever, owing to the characteristic severe pain it can cause in bone and joints, is a viral disease caused by one of the arboviruses (flavivirus), and is transmitted by mosquitos (Figures 3 and 4). In a consultation, "Key issues in dengue vector control to-

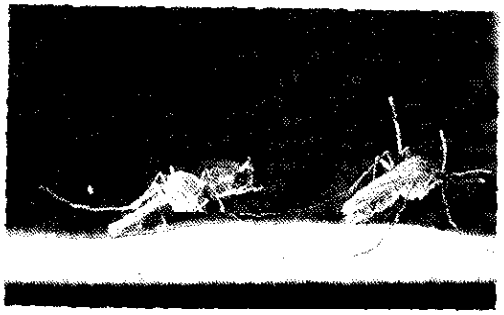

Figure 3 ***Culex*** **mosquito, vector of dengue**

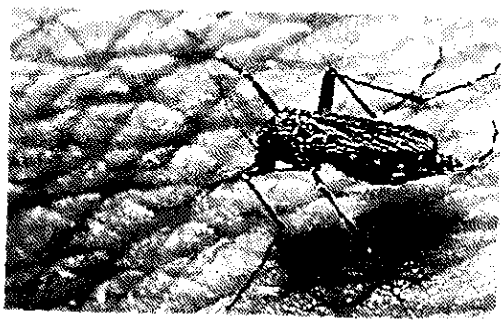

Figure 4 ***Aedes*** **mosquito, vector of dengue**

wards the operationalization of a global strategy", which was held at WHO headquarters in Geneva from 6 to 10 June 1995 to define a global strategy for the prevention and control of dengue fever and dengue haemorrhagic fever/dengue shock syndrome, it was recognized that dengue fever and dengue haemorrhagic fever outbreaks were increasing in frequency globally. Dengue was recognized to be of public health concern in urban and periurban as well as in rural environments. Two thousand million people are estimated to be at risk of dengue fever and dengue haemorrhagic fever.

In the absence of specific treatment and vaccine, the global dengue prevention and control strategy basically depends upon prevention and control measures to eliminate or drastically reduce the population of mosquito vector *Aedes aegypti* in a sustainable way; also early diagnosis and prompt management of dengue haemorrhagic fever and dengue shock syndrome are vital. To achieve these objectives, it is necessary to integrate dengue vector control with other vector-borne disease control programmes; strengthen technical and institutional resources for vector control at country level; and mobilize all possible resources to involve the community in vector control for sustainability.

Dengue history in the Eastern Mediterranean Region

Dengue fever was widespread in many countries in the Eastern Mediterranean Region during the 19th and first half of the 20th century. A decline in dengue transmission was recorded in Egypt after 1940. This decline was attributed by Darwish and Hoogstrall [*1*] to rapid decrease of *Aedes aegypti* populations with the introduction and widespread use of dichlorodiphenyltrichloroethane (DDT) during and after the Second World War.

Dengue activity was reported in Somalia in 1982 [*2*]. Between 1985 and 1987 a serological survey during an outbreak of febrile disease in refugee camps near Hargeisa, northern Somalia, confirmed dengue activity [*3*]. In Sudan, dengue activity was detected through another serological survey, in which 17 isolates of dengue type 2 and one of dengue type 1 were detected [*3*]. In 1992, an outbreak of febrile illness in Djibouti was found to be due to a mixture of malaria and dengue [*4*]. Pakistan first reported an epidemic of dengue fever in 1994, and dengue fever cases were reported from Saudi Arabia in 1994 [*5,6*]. The evidence for local transmission of dengue fever cases in Jeddah, Saudi Arabia, was presented by Ghaznawi in 1995 [*7*], who also confirmed the presence of dengue vector mosquitos *Aedes aegypti* and *Aedes albopictus* in different districts of the city.

In the light of recent history, it can be said that recently persistent and active dengue transmission has not been observed, but sporadic outbreaks are occurring in some countries, and that dengue in this Region appears to be re-emerging after an absence of about half a century. There is good evidence that fresh transmission of dengue through its vector mosquito *Aedes aegypti* is taking place.

The main factors behind the recent re-emergence of dengue in the Region are:

- Decreased use of DDT. At present application of DDT is not favoured because of development of insecticide resistance in vectors or global environmental concerns.
- Rapid urbanization and the resultant development of slum and shanty towns around urban centres. Such unplanned human habitations usually lack civic facilities such as proper sewerage systems, and hence the possibility of vector/pest proliferation.

Table 1 **Distribution of important *Culex* and *Aedes* mosquitos in the Eastern Mediterranean Region**

Member State	Mosquito							
	Culex pipiens	*Culex molestus*	*Culex antinatus*	*Culex quinque-fasciatus*	*Culex univitatus*	*Aedes aegypti*	*Aedes caspius*	*Aedes albopictus*
Afghanistan	+					+		
Bahrain				+		+		
Cyprus	+							
Djibouti	+			+		+		
Egypt	+		+		+		+	
Iran, Islamic Republic of	+			+	+		+	
Iraq	+							
Jordan	+	+	+					
Kuwait			+	+	+		+	
Lebanon	+							
Libyan Arab Jamahiriya	+					+		
Morocco	+							
Oman				+		+		
Pakistan	+			+		+		+
Qatar				+				
Saudi Arabia	+			+		+	+	
Somalia				+		+	+	
Sudan				+		+		
Syrian Arab Republic	+					+		
Tunisia	+					+		
United Arab Emirates				+		+		
Republic of Yemen	+			+		+		

+ = species present

- The large number of displaced human populations, many of them living in refugee camps (in Afghanistan, Djibouti, the Islamic Republic of Iran, Pakistan, Somalia, Sudan). These populations are more prone to mosquito bites.
- Rapid and increased means of human transport, which have increased the chances of introducing pathogens and vectors.
- Inadequate attention to *Aedes* control in urban areas.
- Community awareness about dengue and vector mosquitos, which is very low in general.

Dengue control

Aedes aegypti, the main vector mosquito, has been recorded in 13 of the 22 countries of the Eastern Mediterranean Region. It is known as a domestic mosquito, found inside and near human habitation. It is commonly considered to be an urban mosquito, but it breeds in rural areas with equal ease. In some countries of the Region, *Aedes aegypti* is found breeding in natural receptacles such as tree holes, but always near human habitation. The distribution of *Aedes aegypti* in the Region is given in Table 1. Classical dengue is believed to originate in south-eastern Asia, where the mosquito *Aedes albopictus* is the principal indigenous vector [5,6]. In the Eastern Mediterranean Region, *Aedes albopictus* is a lesser vector of dengue and has been recorded in Pakistan only. The role of *Aedes albopictus* as a vector of dengue in the Region needs confirmation.

Progress is being made in developing a panflavivirus vaccine. Difficulties persist because of lack of appropriate animal models to test the attenuated vaccines and also because of antibody-dependent enhancement of viral growth [2].

In view of the above, elimination or drastic reduction of the population of mosquito vectors *Aedes aegypti* and *Aedes albopictus* remains the main control measure.

Control of dengue vector mosquitos in Eastern Mediterranean Region

In view of the sporadic nature of dengue outbreaks, vector control programmes that are specifically devoted to eliminating or controlling *Aedes aegypti* or *Aedes albopictus* do not exist. Vector suppression activities are undertaken only in the case of outbreaks, which are mostly limited to ground or aerial application of pesticides.

The culicine or *Aedes* mosquito populations are, to some extent, kept suppressed through national malaria control programmes, or in some malaria-free countries by disease vector/pest control programmes, as they use chemical pesticides (a wide range of organochlorines, organophosphates, carbonates and pyrethroids are used). Some countries also use biocides. Trials with *Bacillus thuringiensis* H-14 and *Bacillus sphaericus* have been carried out in some countries. Recently, in response to a regional initiative on integrated vector control, considerably more effort will be invested in making full use of this method. The integrated vector control approach utilizes the most suitable combination of environmental, chemical and biological control. Biological control of vector mosquitos is mainly by the use of larvivorous fish. At least, 15 out of 22 countries are using or have used larvivorous fish, such as *Gambusia affinis*, *Tilapia mozambica*, *Aphanius dispar* and *Oreochromis* species, for mosquito larval control. But this method is still far from perfect.

Conclusion

In conclusion, a number of vector-borne diseases are re-emerging in the Eastern Mediterranean Region due to a number of natural and man-made factors. To prevent the emergence of new vector-borne diseases and re-emergence of those already under control, it is essential to strengthen national vector control programmes. Vector control activities must be integrated both by bringing together different vector control methods—environmental, biological and chemical—and by coordinating the vector control activities of various vector-borne disease control programmes (against malaria, filariasis, leishmaniasis, dengue, flea- and rodent-borne diseases and other arboviruses of public health significance). This is a trans-

disease control approach for cost–effectiveness and sustainability. It is also very important to have an efficient and sustainable surveillance system for the vectors and their resistance to various insecticides. Those countries that are epidemic prone must develop and maintain emergency preparedness plans.

In accordance with the regional vector control strategy, an integrated vector control strategy should be implemented with maximum community participation and using primary health care as the main vehicle for sustainability of achievements.

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