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Master's course: International Medicine and Health Crisis Management

Insect vector-borne diseases in Greece.

Are the public health services efficient?

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Athens

May 2012

Abstract

Emergence of infectious diseases poses a serious public health threat that will be intensified in the future due to a number of factors such as climate change, environmental conditions, agricultural land use, migration, travel and trade. About 30% of infectious diseases are transmitted to humans by insects such as mosquitoes, flies, fleas, ticks and mites. Several species of these vectors are abundant in Europe and in Greece. Surveillance systems operate at national and European levels to record insect population density, serologic presence of pathogens in reservoir hosts and infectious disease cases. Cases of malaria, West Nile virus, Crimean-Congo haemorrhagic fever and Leishmaniasis have recently been recorded in Greece. In addition, dengue fever, Chikungunya, Lyme disease and several forms of viral encephalitis are present in several European countries. Insect vector-borne diseases are a significant public health problem that requires coordinated planning and intervention among the health services sector, the veterinary services and the public health authorities. Prevention of transmission, vector control, health awareness, implementation of preventive measures to reduce exposure and routine surveillance are essential measures that need to be taken in order to minimize the risk of infection and the disease burden on the EU population.

Key words: infectious diseases, insect vectors, Greece, Europe, public health measures, surveillance

Περίληψη

Η εμφάνιση λοιμωδών νοσημάτων αποτελεί σοβαρό κίνδυνο για την δημόσια υγεία, ο οποίος αναμένεται να ενταθεί με την πάροδο των ετών λόγω αιτίων όπως η κλιματική αλλαγή, οι μεταβαλλόμενες περιβαλλοντικές συνθήκες, η αλλαγή χρήση της καλλιεργήσιμης γης, η μετανάστευση, οι μετακινήσεις και το εμπόριο. Περίπου 30% του συνόλου των λοιμωδών νοσημάτων μεταδίδονται στον άνθρωπο μέσω φορέων όπως είναι τα κουνούπια, οι μύγες, οι ψείρες, τα τσιμπούρια και τα σκαθάρια. Αρκετοί από αυτούς τους φορείς βρίσκονται εν αφθονία στην Ελλάδα και στην Ευρώπη γενικότερα. Συστήματα επιτήρησης λειτουργούν σε εθνικό και σε ευρωπαϊκό επίπεδο με στόχο την καταγραφή της πυκνότητας του πληθυσμού των εντόμων, την ιολογική παρουσία των παθογόνων στους ξενιστές και τηνκαταγραφή περιστατικών νοσημάτων. Προσφάτως στην Ελλάδα καταγράφησαν περιστατικά ελονοσίας, πυρετού του ιού του Δυτικού Νείλου, αιμορραγικού πυρετού Κριμαίας-Κονγκό και λεϊσμανίασης. Επιπλέον σε αρκετές χώρες της Ευρώπης, καταγράφονται περιστατικά δάγκειου πυρετού, πυρετού Chikungunya, νόσου Λάϊμ και διαφόρων μορφών ιογενούς εγκεφαλοπάθειας. Τα μεταδιδόμενα μέσω εντόμων-φορέων λοιμώδη νοσήματα αποτελούν σημαντικό πρόβλημα δημόσιας υγείας, η ανιμετώπιση του οποίου απαιτεί συντονισμένο σχεδιασμό και εφαρμογή μεταξύ του τομέα υπηρεσιών υγείας, των κτηνιατρικών υπηρεσιών και των αρχών δημόσιας υγείας. Πρόληψη της μετάδοσης, έλεγχος του πληθυσμού των εντόμων, εγρήγορση σε θέματα δημόσιας υγείας, λήψη προστατευτικών μέτρων και συστηματική επιτήρηση αποτελούν τα απαραίτητα μέτρα τα οποία πρέπει να ληφθούν προκειμένου να μειωθεί ο κίνδυνος μόλυνσης και η επιβάρυνση νόσου στον πληθυσμό της Ευρώπης.

Λέξεις-κλειδιά: λοιμώδη νοσήματα, έντομα φορείς, Ελλάδα, Ευρώπη, δημόσια υγεία, επιτήρηση

Introduction

During the past decades global climatic change along with socioeconomic factors, migration and globalization have led to an increase in the emergence of several infectious diseases in several parts of the world. A study reports that in the 60 years prior to 2004, a total of 335 new diseases have been recorded in the US, Australia and the countries of Western Europe (1).

Given the fact that all these factors will be intensified in the future, it is safe to assume that the emergence of infectious diseases will continue to grow and that there is need to adapt current public health practices and to devise new strategies in order to achieve effective disease control and protect human health.

The European Centre of Disease Control (ECDC) in an expert consultation (July 2008) visualized the socio-ecological context in the European Union (EU) in 2020 based on assumptions on the factors related to the emergence of infectious diseases (2). These factors relate to globalization and environmental change, travel and tourism, migration, global trade, demographic change and social inequalities, health-related lifestyles, public health system parameters, animal health and food safety, novel pharmaceutical products and surveillance and reporting systems.

The infectious disease map in the EU over the following years is expected to be adversely affected by environmental and climate changes, migration, increased travel activity for business and recreation purposes.

Climate changes in the immediate future are expected to lead to increased floods in Europe and a rise in air and water temperatures which will inevitably lead to change in the distribution and frequency of diseases spread through vectors, food and water (3,4).

Intensive land use along with resistant insecticides is an important determinant of infectious diseases. In Europe, agriculture is the main occupational activity for over 7 million workers (approximately 5% of the total EU workforce) who use 55% of the total land area (5). One result of the extensive land use will be the inevitable adaptation of wildlife population to new conditions, change of habitats, mutations and presence in new areas.

Migration is increasing globally and will be intensified by the economic crisis and the associated changes in living standards of people and poverty status of large segment of the population. Moreover, projections show that the European population growth from 2015 will depend on migrants (6). It is estimated that the current migrant population in Europe (EU-27)

amounts to 6.5 % of the total (7). Migrants are a very heterogeneous group in terms of health background, practices and vulnerability; especially those coming from less developed countries with high prevalence of infectious diseases, therefore their characteristics must ne taken into consideration when planning and implementing public health measures.

Travel activity in Europe has been affected by the current financial hardship, but it is foreseen to grow by the year 2030 by 40% for trade and by 34% for tourism according to the European Commission (8).

Insect vectors & disease

Vector-borne diseases constitute a challenging public health issue because they implicate several disciplines and public services/authorities in order to achieve efficient recording and disease control. Almost 30% of all recorded infectious diseases are transmitted through insect vectors (9). There is specific need for disease risk assessment, vector monitoring, surveillance and appropriate vector control measures. In order to combine the needs of different disciplines ECDC has set up VBORNET, a network of public health experts and medical entomologists, aiming at facilitating communication and exchange of information (9,10).

Mode of transmission

Vector-borne diseases are diseases transmitted to people by arthropods feeding on human blood that carry an infectious agent. Arthropods that play the role of vector usually are insects such as mosquitoes, flies lice and arachnids such as ticks and mites. The vector is usually the carrier of the infectious agent and does not suffer from the disease. Once the vector feeds on the infected vertebrates, it becomes infected; the agent multiplies inside the arthropod and hereby transmits the disease through its salivary glands to humans, rodents, domestic or other animals, birds. Overall, 85% of total animal species that can act as vectors are arthropods.

Mosquitoes and ticks are the most important vectors and disease transmission depends mainly on the infectious agent, the vector and the human host. Many infectious diseases rely on animals for their transmission and are also called zoonoses. Quite often animal hosts act as reservoirs for an infectious disease until a susceptible human population becomes infected after exposure, but for some diseases such as malaria and dengue, humans are the major host.

The occurrence of vector-borne infectious diseases relies mainly on the population size of the insects, intermediate and reservoir hosts, the prevalence of infectious pathogens depending on the insects for their transmission to humans or animal hosts, the physical conditions in the area (mainly heat and humidity) and the behaviour (contact of humans and vectors) as well as the immunity level of the human population.

Insect vector borne diseases in Europe

Infectious diseases are more prevalent in warm climate zones and less frequent in areas with temperate or cold climates.

However, over the past 40 years, several insect-borne infectious diseases are re-emerging across the world and particularly in Europe, such as malaria, dengue fever, West Nile viral encephalitis, Leishmaniasis, Lyme disease, Crimean-Congo haemorrhagic fever and Chikungunya. Yellow fever is an infectious disease transmitted by mosquitoes that has not been reported in Europe, except of cases of travelers in endemic areas (11).

As already mentioned, the majority of vector-borne infectious diseases are transmitted by mosquitoes and ticks. There are more than 3,000 different types of mosquitoes worldwide. Only the female mosquito is capable of transmitting disease because there is need to feed on blood in order to provide protein for egg formation.

The Anopheles mosquito (bites usually by dusk and dawn) is the known competent vector for malaria. Malaria is only reported as an imported disease nowadays usually due to travelers returning from malaria endemic areas. However, many counties in the WHO European region are still reporting malaria regularly, e.g. Turkey, Azerbaijan (12).

Anopheles mosquito

The Culex mosquito (typically bites by dusk and after dark) is the typical vector of the West Nile virus. The Asian tiger (Aedes albopictus) mosquito (bites by day) has been associated with the disease transmission, but it is still not certain whether it is a competent vector. A

large outbreak of West Nile virus in humans has been reported in Romania in 1996/97 and more recently in Greece in 2010. Other European countries with cases since the 1950's include Austria, Bosnia, Croatia, the Czech Republic, France, Hungary, Italy, Portugal, Spain and the Ukraine (13).

House Mosquito (*Culex* sp.)

Asian Tiger Mosquito

The Aedes aegypti mosquito (bites by day and prefers humans) is a vector for dengue fever and yellow fever. Both the Aedes aegypti and Aedes albopictus mosquitoes have been identified in Europe. France and Croatia have reported cases of dengue fever in September 2010 (14).

Aedes aegypti

Sandfly

Chikungunya fever disease is transmitted by mosquitoes of the Aedes family. Aedes albopictus mosquitoes have been identified in Europe since the outbreak of the disease in Italy in 2007 (15).

Dirofilariasis is a parasitic disease transmitted to humans from dogs and cats (zoonotic) by the bite of infected Aedes or Culex mosquitoes. Some cases of the disease have been reported in Italy, France, Hungrary, Latvia and Russia. (14)

Leishmaniasis is transmitted by sand flies which are closely related to mosquitoes, feed on blood and their bite causes discomfort for several days. Populations of sandflies have been identified in samples taken from France, Spain, Greece and even northern Germany (16).

Sandflies in Europe are mostly active in the summer months and there is a shift of the disease spread from Southern to Northern Europe due to climatic and environmental changes (11).

The Hyalomma tick and especially the H. margnatum type is the main vector for the Crimean Congo haemorragic fever (zoonotic disease) along with sever other tick types, transmitted by bite to humans after the consumption of infected livestock and is endemic in Eastern Europe, the Middle East and Asia (17).

Hyalomma tick

Hyalomma marginatum

Lyme Borreliosis is the commonest tick-borne disease (tick vector Ixodes ricinus-deer tick) reported in Europe. A total of 85,000 cases are reported annually and its incidence is increasing in Northern European countries such as Germany, Finland, Slovenia and Sweden (13).

Insect vector-borne diseases in Greece

Malaria is transmitted in humans by bite of a mosquito of the Anopheles family infected with the Plasmodium parasite. Five Plasmodium species affect humans but *P.falciparum* and *P.vivax* are the most dangerous ones and account for over 95% of cases worldwide. *P. falciparum* malaria is the most serious form, mainly because infection does only leave very limited immunity to the affected individual, hence re-infection results in debilitating and even deadly disease due complications. *P. vivax* malaria is usually a milder disease and is very rarely fatal. Treatment for both forms can only be effective if the symptoms are quickly identified as Plasmodium infection and action is taken promptly, so clinicians should be aware of the malaria clinical manifestations and report suspected cases to the relevant authorities. Although *P.vivax* has the widest distribution in the world, malaria is not considered endemic in the EU and the surrounding countries (18).

Autochthonous cases of malaria in Greece have been reported occasionally since the eradication of malaria in the 70s. In 2009, 2010 and 2011 consecutively, a number of autochthonous cases of malaria have been detected in the same area of Evrotas-Lakonia in southern Pelopenese (19). The presence of Anopheles mosquitoes in Greece is well known and from June until late July 2011, 4 autochthonous cases of *P.vivax* malaria have been identified in the area of Evrotas and 2 in Chalkida, Evia (cases in Greek citizens, successfully treated, not belonging in any minority group and not associated with recent travel in malaria endemic countries). In both these areas there is abundance of migrant farm workers coming from endemic malaria areas (India, Pakistan, Afghanistan etc.). The cases of *P. vivax* malaria reported in Greece until September 2011 mount up to 20 cases without prior travel history to endemic malaria areas (20).

According to ECDC (2011), despite the implementation of intense control measures and data collection, it is still not possible to identify whether the local transmission is due to an imported case of malaria infecting the area residents by bite of an Anopheles mosquito, or whether there is a human reservoir in the area which will continue producing cases of *P.vivax* malaria. The current stand is that Greece poses low risk for malaria autochthonous transmission in the EU Member States, mainly because the species distribution of the Anopheles mosquito in Europe seems to be unaffected from climate and environmental changes. Certainly, such changes cannot be excluded in the future, so continuous and effective monitoring of the Anopheles mosquito population in the areas/countries where present is important. Several action and control measures were promptly taken by the Greek authorities; the situation is closely monitored and is thought to be of limited risk to the rest of the EU (19).

Malaria preventive measures are very important, mainly because there is no effective vaccine to provide full immunity, reason being the complexity of the protozoan genomic complexity and metabolic rates.

West Nile fever is caused by the West Nile virus of the Falaviviridae family and is transmitted to humans by bit of infected Culex and Aedes albopictus mosquitoes. Such mosquito populations are present in many European countries and outbreaks have been recorded since 1996 (Romania), 2000 (Israel and Southern France). (21). The West Nile virus is associated with mild winters, heat waves and dry spring and summers. It is considered an important public health threat and studies show that it may be transferred across continents by migrating birds. The West Nile virus is part of the Japanese encephalitis pathogenic group.

Although 80% of infected humans remain asymptomatic, the infection can rarely have serious complications especially in patients with predisposing conditions.

A West Nile infection outbreak was reported for the first time in humans in Greece in August 2010 (11). Overall, 262 cases in Central Macedonia were notified to the Hellenic Centre of Disease Control and Prevention. Transmission was by bite of infected Culex pipiens mosquitoes. The Central Macedonia area has large proportions of wetland favouring mosquito reproduction, is in the route of migration birds and the weather conditions for 2010 indicate a warmer and wetter season than usual (22). Following the outbreak, the Greek authorities have taken a series of control measures in order to increase awareness and prevent further spread of the viral infection (23).

Leishmaniasis is a zoonotic disease caused by the *Leishmania* parasitic protozoans and it transmitted to humans by the bite of infected female phlebotomime sandfly. Two are the main species endemic in Europe, *Leishmania infantum* causing visceral and cutaneous leishmaniasis in humans and domestic dogs and *Leishmania tropica* causing anthroponotic cutaneous leishmaniasis. Primary skin infections are usually mild and develop acquired immunity, but secondary infections and onset of visceral leishmaniasis could be fatal without treatment (24).

There is high prevalence of *L. infantum* in southern Europe, hence the parasite is a public health threat. In Greece, up to 2009 sporadic presence of *L. tropica* has been recorded whereas *L.infantum* (cutaneous and visceral) are present (25). Similar data come from Spain, France, Italy, Malta, Cyprus and Portugal. According to the WHO Regional Office for Europe, 2007 (26) a total of 390 leishmaniasis cases have been reported in Greece in the period 1996-2005, of which 20-30 cases were zoonotic visceral (reported through the Centralized Information System for Infectious Diseases-CISID).

The main risk factors for the disease are environmental and climate change, therefore seasonal variations affect the population growth of sandflies and increase risk of Leishmania infection (27). Sandflies are not as powerful as some mosquito species, so it is unlikely that inter-continental vector import can occur. Deforestation and agricultural land use modification is very likely to affect sandfly population and consequently the occurrence of leishmaniasis cases (28). Occasional cases of leishmaniasis are reported annually in Greece from various areas in Greece, especially Crete (29).

Crimean Congo viral hemorrhagic fever is an acute disease transmitted by bite of the Hyalomma marginatum tick. Domestic and wild animals carry the virus being asymptomatic

themselves. Migrating birds also pose a risk for transmission. From 2000-2008 several cases have been reported in Albania, Kosovo, Bulgaria and Turkey. The virus is also present in France, Portugal and Hungary (30).

The first ever reported case of Crimean Congo haemorrhagic fever in Greece appeared in June 2008 in a woman farmer in the area of Rodopi in Northern Greece after a tick bite. Although treatment with ribavirin was administered, the patient developed complications and died 7 days after the onset of symptoms (31). There is a seasonality of Crimean Congo haemorrhagic fever cases which follow the tick activity, which in turn is affected by the environmental and climate changes along with changes in farming activities that affect the population of infected animals.

Following the notification of the first ever case in Greece triggered a series of actions by the authorities which usually require extensive collaboration with the veterinary services, environmental interventions and serological surveys.

Climate change and emergence of vector borne diseases

Climate is a term used to describe the conditions of the natural elements prevailing in a region or zone, whereas weather describes the climatic conditions in a short period of time (32). A number of factors such as sun energy variations, particle distribution in the atmosphere and changes in the earth's orbital movement are related to climatic changes. Weather and climate have always affected human activities from everyday to occupational activities such as farming, fishery, cattle breeding etc.

Despite the technological advances of the recent decades, the interest of the human race in predicting the weather has not diminished; in fact it has evolved into a highly specialized form of science with direct links to the smooth operation of many occupational sectors.

Moreover, the weather affects the life cycle of all living creatures and as a consequence its changes have an impact on the selection of species and survival. Temperature changes can increase or decrease vector survival, can change the vector's population growth, their seasonality, their susceptibility to some pathogens, as well as their feeding rate (33).

The pathogen's incubation period in the vector can be affected by higher temperatures, as well as the distribution and viral replication (26). It is well known that changes of the weather conditions affect the vector's ecosystems, but those interact with the insects' ability to adapt to the new conditions.

Since the eighteenth century the global temperature of the earth is rising, a fact which is associated with favourable living conditions for mosquitoes and other insects known to be related to several diseases.

Control systems- surveillance of vector borne diseases

The vector-borne infectious diseases are among the most difficult to control and prevent because they form an integral part of the ecosystems they live in. Yet, vector control is an absolutely necessary measure in the effective prevention and treatment of the diseases.

The main characteristic of vector-borne diseases is the high transmissibility that relies on the high mobility and dispersion of the carriers. It is important to note that vectors have a relatively increased life span (e.g. a mosquito can live up to 9 months) and that they can detect danger, an instinct that reduces the effectiveness of control programmes (e.g. they smell insecticides and move to non-sprayed areas, some feed during the day, others in the night –time).

Control methods generally focus on the restriction of the arthropod vector such as installing protective measures (use of nets in the windows, doors and beds), wearing appropriate clothing (long sleeved tops, trousers, boots etc.), and personal use of insect repellents.

Environmental modification that targets the vector population in an area such as the elimination of specific breeding areas, destruction of larvae, spraying with insecticides may also be undertaken.

Since travel is an important factor of vector-borne disease transmission, it is helpful to monitor ports of entry to a country (airports, ports) in order to prevent vector import from foreign countries.

The second level of control measures focuses on the pathogen itself, through effective vaccination. Such is the case of yellow fever, tick-borne encephalitis and other diseases. Moreover, it is possible to target the vertebrae host and/or the host reservoir. For example, the vaccination of foxes against rabies in Europe and Canada effectively reduces the risk of rabies in these areas. The reduction of host reservoirs i.e. the elimination of rodents and birds from the urban areas reduces the risk of certain vector-borne diseases (34).

Public health importance- Control measures in Greece

Greece is a country with temperate climate, with relatively mild winters and hot summers. Such conditions usually favour the presence of many vectors of infectious disease, therefore there is need to implement vector surveillance and control systems in order to prevent infectious disease spread.

The main authority responsible for monitoring and surveillance of infectious disease at the National level is the Hellenic Centre for Disease Control and Prevention (HCDCP/ KEELPNO) where a passive surveillance system for notifiable diseases is operating for a number of diseases. This list is regularly updated in accordance with data reports and evidence from the local and European reporting systems. In cases of diseases outbreaks, such as the recent malaria outbreak, the surveillance systems are enhanced, active case finding is implemented and the laboratories are alerted. In the event of emerging diseases, such as the case of WNV infection and malaria, this surveillance system is enhanced with active surveillance in order to respond to the outbreak. Such an example is the introduction of the WNV surveillance in August 2010, after the detection of the first encephalitis cases in Northern Greece.

HCDCP/ KEELPNO collaborates closely with the European Centre for Disease Control (ECDC-based in Sweden) in surveillance and control activities, which in turn closely relates to the reporting systems of WHO Regional Office for Europe (based in Denmark). A series of networks have been set up implicating many Member States, the EU, the ECDC and WHO that aim at the control of communicable diseases in Europe, such as EPISOUTH, VBORNET etc (10, 35).

Due to the fact that many of the insect vector-borne diseases are zoonotic, no public health measure would be effective without the collaboration of the veterinary authorities. Greece has managed to control many infectious diseases, to implement environmental interventions and to increase health awareness on the risks of disease transmission at the local level trough close cooperation with the veterinary services in the past years (malaria and West Nile outbreaks).

Public health measures also include methods for vector monitoring and control and environmental interventions on the reservoir hosts. Spraying areas with insecticides, control of animal reservoirs against vector bites, have been efficient in controlling transmission of vector-borne diseases (36, 37).

The presence of reference laboratories (e.g. the Arbovirus laboratory in the Aristoteleion University of Thessaloniki) to detect presence of special microorganisms, to analyse samples

for animal serologic and entomologic studies is very important in order to define the presence of various infectious agents in endemic or high risk areas. Moreover, the collaboration with relevant veterinary laboratories in the Public Health sector or academia (veterinary schools) can be very efficient.

Actions on the pathogen itself have also the potential of reducing risk transmission. This can be achieved though vaccination, a preventive measure that forms part of a national health policy. Unfortunately, there is no vaccine available for most insect vector-borne diseases apart from Yellow fever and Japanese encephalitis. The malaria vaccine offers very limited protection (maximum 50%) and cannot be considered effective means of protection from malaria transmission.

Below is a short overview of the measures taken in Greece in the recent insect vector-borne disease outbreaks.

Multi sector collaboration for the implementation of vector control measures, communication to the public for the timely use of appropriate personal protection measures and communication to health professionals to increase awareness are the cornerstones of effective disease control.

Malaria

The Hellenic Centre for Disease Control and Prevention (KEELPNO) enhanced surveillance for the identification of additional potential cases of malaria in the affected areas (20).

Blood safety measures for donors from the affected areas.

Entomological investigations for the presence of Anopheles mosquitoes in the affected areas

Control measures to reduce the mosquito population through spraying larvae and adults with insecticides (permethrin).

Health promotion activities in the area to inform about malaria targeting health professionals and the general population (pamphlets, brochures, posters, TV spots etc).

Link of KEELPNO with the European Surveillance System (TESSy).

Vector control activities are focused in Indoor Residual Spraying (IRS) and larviciding to be performed early and regularly in the season. The technical competence to support spraying is currently lacking in regional governments, therefore the responsibility for spraying activities

is tendered to private companies. This is not necessarily a bad scenario, but such activities must be performed in relation with a governmental inspection and control mechanism to assess performance. Unfortunately, in the current situation such mechanisms have been eliminated due to small number of health inspectors, lack of specialized knowledge and time restrictions.

West Nile fever

Upon notification of the first cases, the Hellenic Centre for Disease Control and Prevention initiated an awareness campaign addressing all clinicians practicing in Greece and especially in the area of Central Macedonia on the clinical manifestations of the West Nile fever by distributing a set of guidelines and details on laboratory diagnosis (22).

Blood safety measures were established, testing all blood samples and blood products from the area (residents or visitors).

The Ministry of Health and Social Solidarity intensified the mosquito control activities in collaboration with the veterinary services of the Ministry of Agriculture such as spraying with insecticides and use of bait traps to account for the mosquito population (23).

Crimean Congo haemorrhagic fever

Following the notification of the first ever case of the disease in Greece in 2008, a series of measures were taken.

Draft of a set of guidelines addressing health professionals was produced and disseminated to all healthcare facilities in Northern Greece on indicated methods of disinfection of medical equipment, working areas, medical waste management, handling of blood samples and blood products and indicated treatment. Moreover the guidelines included information on the prevention of tick bites, protocol of tick removal. Such messages were also announced to the general population through various forms of media (TV spots, leaflets etc.).

The Hellenic Centre for Disease Control and Prevention in collaboration with the Ministry of Agriculture also organized the conduct of serologic surveys in humans and animals in a large area of Northern Greece and also tested ticks living in the area (31).

There was also discussion of expanding the area under surveillance in cooperation with ECDC (Crimean Congo haemorrhagic fever is a notifiable disease) in many more prefectures

than the one the case appeared, because there are large populations of Hyalomma tick in those areas.

Crimean Congo Haemorrhagic fever is a serious disease endemic in countries of Eastern Europe with high mortality, carrying potential of human-to-human transmission, misdiagnosis of symptoms and requirement of strict control measures. The environmental, climate changes favour the occurrence of disease cases in Greece and other European countries, although at the present stage, it is considered that this case was an isolated event.

Leishmaniasis

Leishmania parasites are endemic in Greece and many other European countries, therefore good surveillance, prompt diagnosis and treatment should be a priority of the public health authorities in order to reduce the risk of anthroponotic leishmaniasis. In Greece Leishmaniasis is a notifiable disease at the municipality level and in the endemic areas of Italy, Turkey, Portugal and Spain. Moreover, collaboration with the veterinary services is essential in order to control infection of animal hosts.

The fact that in the majority of cases the disease remains asymptomatic, indicates that re-emergence of Leishmaniasis is very likely and this realistic threat should not be underestimated.

The indicated measures for disease control include methodologies for surveillance and control of anthroponotic transmission, better tools for case detection and treatment and improved sandfly control, e.g. long lasting insecticide bednets. The use of deltamethrin impregnated dog collars are very effective in reducing transmission and protect against sandfly bites (28).

Conclusions

The climatic conditions in Greece offer favourable living conditions for many mosquito types, vectors of infectious diseases. It is characteristic that several diseases eradicated in the past from Greece are now re-emerging due to the change in weather conditions, urbanization and proximity of vectors to humans, as well as migration from countries where these diseases are endemic. Such is the example of malaria, which was eradicated in Greece in 1974, but sporadic cases are now being reported. Dengue fever is no longer present in Greece following the massive epidemic of 1927-1928 which cost the life of over 1,000 people (38). Yellow

fever also being a mosquito transmitted disease has the potential of emerging in Europe and in Greece, since the presence of Aedes albopictus (established in Europe in the 1970s) is capable of generating transmission (32). Aedes aegypti (the typical vector of yellow fever and dengue) was present in parts of Europe, but disappeared from the Mediterranean region for unknown reasons in the 1970s. Travel and trade between Europe and countries where yellow fever is endemic is on the rise, therefore re-introduction of the A. Aegypti vector is likely (39). The public health authorities could assume that the manifestation of autochthonous cases of dengue and yellow fever in Europe and in Greece is plausible.

On the other hand, the impact of the economic crisis in the European region is of major concern for the capacity of the public health infrastructure to control infectious disease spread. It is estimated that over 80 million people in Europe live in poverty conditions with the youngest and the eldest affected mostly (40).

The implementation of austerity measures across all EU-Member States will inevitably lead to reduced public expenditure, deterioration of living standards and social exclusion. As a consequence public health programmes are expected to suffer a serious draw back with the excuse of public spending cuts and reset of priorities (41). The current infectious disease burden in Europe does not justify emergency measures and preventive actions. As a result, disadvantaged and hard-to-reach populations will be even more susceptible to infections due to low immunization coverage, overcrowding, inadequate sanitation and limited health services.

Moreover, the factors associated with the emergence of infectious diseases namely the climate and environmental changes, change of agricultural use, urbanization, migration and increased travel will inevitable lead to changes in the patterns of infectious diseases in terms of increased incidence and area of manifestation. Such particularly vulnerable populations are the undocumented migrant farm workers, which are involved in the cycle of malaria transmission in Greece. Various issues regarding their approach and treatment have arisen such as cost of health care and intervention, migration national policies etc.

The emergence of vector-borne diseases in a particular area has also financial implications by affecting tourism and other local activities.

As a result, there is immediate need for global governmental action to devise strategies and prioritize public health preventive actions. The public health systems must be re-organised and equipped in order to face the future challenges.

Suggestions

The primary measure to control vector-borne diseases is the operation of reporting and surveillance systems that will provide accurate and up-to-date information of disease cases and manifestations patterns. Greece through KEELPNO currently operates a satisfactory passive surveillance system for a substantial number of diseases, which certainly can improve. The surveillance alert level achieved for the Athens 2004 Olympic Games has certainly proven that the Greek public health services through determination, effective organization and close monitoring can achieve very high standards in disease control (42).

Collaboration with the ECDC and the WHO is of paramount importance, as well as participation in the relevant disease control networks, transparency and open exchange of information. There have been instances in the recent past, where Greece has shown delayed response in reporting cases of insect vector-borne diseases and that certainly damages the country's credibility and risks adverse reactions and the announcement of health alert notices (as in the case of the 2010 malaria outbreak). Such incidents must be eliminated and effective health communication with the European health authorities and the public must be established and maintained. The role of media must be carefully assessed and specific reporting strategies must be devised and closely followed (43).

Training of personnel in effective health communication and continuous education activities must form a routine, along with continuous training activities on all areas of disease surveillance and reporting.

Environmental control is also an important measure to reduce insect vector-borne disease transmission. Timely insect control has proven very effective in reducing the populations of mosquitoes, flies and ticks, which in turn reduce the number of infected insects and the risk for human transmission. The 2009 West Nile fever outbreak, apart from the climatic conditions observed, has shown that insecticide spraying activities were delayed and there was abundance of mosquito population in Central Macedonia which facilitated transmission.

Collaboration with the veterinary services is vital in effective insect control at the local level and a direct communication line must be operating at all times, so that prompt action can be taken in case of emergency. Collaboration and guidance to the regional authorities, responsible for implementing the vector control activities. Training of health inspectors to act as a monitoring mechanism of the effectiveness of the spraying is essential.

It is clearly impossible for each country to have infrastructure for all laboratory detection techniques, but the establishment of a EU network of specialized laboratories where specific

techniques could be performed is a strategy that could prove efficient in the timely detection of infectious agents and disease control. Appropriate agreements, specimen transfer protocols and quality assurance indicators need to be agreed in advance.

Health education and health promotion activities are effective methods of increasing awareness in public health issues, but they have to be delivered regularly in order to sustain high awareness level in the population. Specific professional groups (healthcare personnel, laboratory workers, veterinarians, farmers, agricultural workers, and cattle breeders) as well as the general public in endemic or high-risk areas must be targeted at regular intervals on insect vector-borne disease risk, methods of prevention, use of personal preventive clothing, effective use of repellents and personal behaviour. Evaluation of health promotion activities is also essential and must be closely monitored by the relevant public health authorities. Other sectors also need to be informed and trained, such as law enforcement personnel (police, fire brigade, special squads) in order to be aware of the implemented measures and policies.

Looking into the current situation and the factors affecting vector-borne disease transmission, the Greek health surveillance and disease control systems will be challenged in the immediate future. The country is in the pathway of migration from developing countries into the western world and it forms the EU border towards the East, a fact that places Greece in a unique position, by being the frontline of contact with different health systems, political situations, cultures and trade. For these reasons, Greece needs to intensify the efforts for smooth operation of the public health services, by applying close monitoring of operation at all levels through en effective hierarchy control system and regular evaluation of activities.

** All insect photos are in the public domain of the Centers of Disease Control webpage (www.cdc.gov) and may be freely used provided the source is acknowledged.

Acknowledgements: The author would sincerely like to thank the scientific coordinating team of the MSc programme “International Medicine and Health Crisis Management” for the opportunity to deal in depth with a very important public health issue.

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