**MEETING** REPORT

# Consultation on mosquito-borne disease transmission risk in Europe

Paris, 26 November 2010

## Executive summary

The number of recent notifications of mosquito-borne diseases in the European Union Member States in 2010 is a matter of concern. These events involved different types of pathogens, some of which are considered typical for tropical areas. Moreover, different groups of mosquito species, invasive as well as native, were involved. The current situation is unusual and triggered a request from the European Commission for a risk assessment. On 26 November 2010 in Paris, France, the European Centre for Disease Prevention and Control called a consultation of experts to assess the risk of mosquito-borne disease transmission in Europe.

The overall objective of this consultation was to acquire a comprehensive understanding of mosquito-borne disease transmission potential in Europe in order to propose recommendations for preparedness actions.

The current events imply the identification of new risk areas for West Nile virus, dengue, chikungunya and malaria transmission in Europe. The presence of West Nile virus is well documented in several European countries and there has been an increase in the number of cases in the EU over the past decade. Different drivers are contributing to this upsurge, but the basic knowledge required to fully appreciate the possible changing epidemiology of West Nile fever in Europe is lacking. The recent autochthonous cases of dengue fever and chikungunya are significant public health events, and indicate that transmission in continental Europe is possible where the vector *Aedes albopictus* is present. The widespread epidemic of dengue and chikungunya in endemic areas creates an increasing risk that cases will be imported into the EU which, in combination with the increasing spread and abundance of *Aedes albopictus*, increases the risk of autochthonous transmission.

The meeting participants recommended the enhancement of surveillance of the exotic mosquito vector species *Aedes albopictus* and *Aedes aegypti,* the continuous monitoring of importation of viremic cases, and awareness of importation of viruses other than chikunkunya and dengue. Multidisciplinary collaboration and awareness would be of value related to the West Nile virus transmission risks.



Stockholm, February 2011

# 1 Background

The founding regulation* establishing the European Centre for Disease Prevention and Control (ECDC) gives ECDC a mandate to strengthen the capacity of the European Union (EU) for the prevention and control of infectious diseases.

The number of recent notifications of vector-borne diseases in the EU Member States in 2010 is a matter of concern. The largest outbreak of West Nile virus (WNV) since the Romanian outbreak in 1996–1997 in humans occurred in Greece and WNV circulation in other EU Member States and neighbouring countries seems intensified. In France and Croatia, the first autochthonous cases of dengue fever in continental Europe were reported since outbreaks in 1927 and 1928 in Greece. Furthermore two autochthonous cases of chikungunya were notified in France, while Spain reported a local malaria case.

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## 1.1 Objectives

The overall objective of this consultation was to acquire a comprehensive understanding of the potential for vector-borne disease transmission in Europe in order to propose recommendations for actions for preparedness.

Specific objectives of the consultation included the following:

- to review the 2010 epidemiological situation of mosquito-borne diseases in the EU and neighbouring countries;
- to identify the potential drivers that could have contributed to the 2010 mosquito-borne diseases transmission; and
- to identify priority actions for preparedness for 2011 and beyond.

* Regulation 851/2004 of the European Parliament and of the Council

# 2 Expert presentations

During the expert presentations an overview of mosquito-borne disease notifications in 2010 in EU countries was provided. Two presentations related to the problem of WNV transmission and possible drivers were given along with one each on dengue and chikungunya transmission. A fifth presentation addressed the issue of importation of mosquito-borne diseases to Europe.

## 2.1 West Nile fever transmission

Since 2009 in the Emilia-Romagna region, Italy, an integrated WNV surveillance system including mosquitoes, birds, horses and humans has been in place. West Nile virus-positive birds were detected in week 19/2009, then horses and mosquitoes (weeks 29–30), and the first WNV-infected humans were observed in week 34.

The following bird species were found positive in the 2009 outbreak: European magpie (*Pica pica)*, carrion crow (*Corvus corone cornix*), European starling (*Sturnus vulgaris*), Eurasian jay (*Garrulus glandarius*), Strigiformes (owls) and Charadriiformes (waders, gulls and auks).

In 2010, mosquitoes, birds and horses were found WNV-positive in the Emilia-Romagna region, but later in the season than in 2009. No human cases were detected.

In contrast to the WNV situation, the circulation of Usutu virus seems to have increased in 2010 compared with 2009 when the virus was detected in mosquitoes (*Aedes albopictus* and *Culex pipiens*) and in birds.

The following conclusions were drawn from the surveillance and longitudinal follow-up in the Emilia-Romagna region:

- *Culex pipiens* was the only mosquito species found consistently infected in the field with WNV;
- West Nile virus infection rates in mosquitoes were highest over weeks 31–34 (August 2009);
- *Culex pipiens'* seasonal abundance did not explain WNV relative activity in 2008, 2009 and 2010;
- *Culex pipiens* density did not increase in the region over the last 20 years;
- bird fauna went through important changes in the last few decades; and
- Usutu virus activity was higher in 2010 than in 2009, whereas WNV was not.

In Italy there is no evidence of bird mortality and the timing of WNV cases does not seem to be related to bird migration or overwintering. Mosquito activity seemed to determine the timing of transmission.

The infection of scavenger birds via the oral route might be important in the bird-to-bird transmission of WNV.

The European policy on wetlands is likely to have an impact on local and migratory bird populations and dynamics. There is a need to pay more attention to bird populations and their role in WNV transmission dynamics and to link it with data from the other countries.

Climate in Europe is changing which might have an impact on vector-borne diseases. Previous studies done in Israel, North America and Eastern Europe have indicated the following:

- Extremely warm conditions (including heat waves) are important factors that instigate the launching of WNV epidemics in the study areas;
- Summer temperatures were found to be one of the most important environmental variables modulating WNV activity.

In 2010, summer temperatures in Europe—and in selected regions in Greece, Turkey, Romania and Russia, where WNV circulation occurred—were higher than normal. No clear common rainfall pattern was observed in these regions. Based on a preliminary analysis, it seems that the increase in the summer temperature should be considered when evaluating the risk of WNV transmission. However, the meeting acknowledged that WNV transmission is multi-factorial. To understand transmission, different drivers related to the pathogen, the host, the vector, ecology and weather need to be taken into account. Moreover, transmission depends on the local ecology and these drivers do not necessarily have the same impact in different ecosystems.

## 2.2 Dengue and chikungunya transmission

The mosquito species *Aedes albopictus* is an Asian species that has recently spread over the globe by international travel and trade (e.g., second-hand tires, lucky bamboo plants) and is currently present in Europe, Asia, Africa and America. In Europe, it is present in different Mediterranean countries. *Aedes albopictus* is well adapted to humans and the human environment where the urban setting provides the mosquito with abundant sources of feeding, resting places and breeding sites.

The biology and behaviour of *Aedes albopictus* determines its success. It is often superior in interspecific competition and has high survival rates. Its flexible breeding biology allows its spread through international trade and travel. The multiple feeding during one gonotrophic cycle* enhances its vectorial capacity. However, *Aedes albopictus* is not well studied in Europe and fundamental knowledge on the exact breeding places, host preference, longevity and vector competence for different geographic strains of dengue and chikungunya is needed.

Conventional control of *Aedes albopictus*—including source reduction, application of larvicides or adulticides, indoor residual spray and community based control—did not always provide the requested impact and innovative methods to control this species might be needed.

In France the species was first detected in 1999, and since 2004 it has spread from Alpes-Maritimes to Menton to Corsica. In 2007, *Aedes albopictus* appeared in the Var department and in 2009 it was detected in Bouches-du-Rhône. It is estimated that the infested area increased from 1000 $km^2$ in 2008 to 4000 $km^2$ in 2009. *Aedes albopictus* was also found in two areas of Marseille in 2009. Although established populations are currently only found on the east of the Mediterranean coastline, *Aedes albopictus* has been sporadically detected as far west as Pyrénées-Orientales, at the Spanish border in the south, and Saône-et-Loire in the north.

*Aedes albopictus* is a known vector of chikungunya in Europe since the outbreak in 2007 in Italy. The viral strain that circulated in France in 2010 originated from northern India and did not have the V226 mutation that is believed to make the virus more transmissible by *Aedes albopictus*.

*Aedes albopictus* has always been considered a less efficient dengue vector than *Aedes aegypti*, but the recent notifications in France and Croatia showed that it can act as a vector of dengue in Europe.

The risk for local transmission of dengue in metropolitan France is related to the following two factors:

- Besides the spatial expansion of *Aedes albopictus*, the data of the oviposition traps suggest an increased density of the vector species in 2010.
- In France between 1 May and 17 September 2010, an 11-fold increase in dengue imported cases compared with the entire 2009 season was observed.

Since 2006 and the widespread epidemic of chikungunya in La Réunion, an enhanced surveillance is implemented each year from May to November in France in the departments where *Aedes albopictus* is established. This enhanced surveillance is part of the national plan to circumvent the spread of chikungunya and dengue viruses in metropolitan France†. Enhanced surveillance, compared with routine surveillance, allows for the reporting and confirmation of suspected cases to be accelerated and prompt actions, including vector control, to be taken. Besides the specific sensitisation of the concerned health professionals, the plan includes a campaign informing the general public on the biology of *Aedes albopictus* and way to control the species.

## 2.3 Trends in importation of dengue, chikungunya and malaria

An increasing trend of dengue and chikungunya imported cases seemed to be apparent from 2008 and 2009 in Europe. The first figures of 2010 confirm this trend, and this is probably related to the ongoing dengue and chikungunya epidemics in endemic areas. No clear trend was observed for malaria.

EuroTravNet, an ECDC funded network of clinicians in travel medicine, is part of the Geosentinel platform (CDC-funded) which is a worldwide communication and data collection network for the surveillance of travel-related morbidity. This platform, in collaboration with the European Network for Diagnostics of 'Imported' Viral Diseases Collaborative Laboratory Response Network (ENIVD-CLRN), an ECDC-funded network for specific diagnosis, facilitates the detection of imported cases and provides information about travel-related cases.

* The gonotrophic cycle is the blood feeding, egg production and egg laying cycle of a female mosquito.

† For more information: http://www.circulaires.gouv.fr/pdf/2010/05/cir_31164.pdf.

# 3 Drivers of mosquito-borne disease in Europe and future risk

## 3.1 West Nile virus

West Nile virus circulation in Europe is well documented. However, in Greece in 2010, the largest outbreak of West Nile virus in humans occurred since the Romanian outbreak in 1996–1997. Moreover, in 2010, many countries were affected at the same time and WNV circulation was reported in new areas. The circulation of WNV lineage 2 was shown in several countries such as Romania and Greece. This lineage has previously been detected in birds in Hungary (2003) and in humans in Russia (Volgograd, 2007).

West Nile virus transmission is complex and influenced by different factors related to the pathogen, the host, the vector, the ecology and the climate. Transmission depends on the local ecology and drivers do not necessarily have the same impact in different ecosystems as, for example, the effect of climatic factors depends on local ecosystems.

To assess future risk, more information is needed on the vector, the birds, and the way the ecosystem interacts and influences the transmission (enzootic transmission and the transmission from the enzootic cycle to humans and horse population). The following is a list of factors and uncertainties to consider when assessing risk:

- The role of local and migratory birds in transmission needs to be better understood as well as the difference between Eastern and Western Europe. The acquired immunity in birds in France and Italy is rather low compared with Romania where bird immunity is high. In Spain, a clear difference between local and migratory birds immunity is apparent, evidences that most sero-positive migratory birds were infected outside Europe.
- Future risk needs to take into account the WNV situation in Africa and the possible spread to Europe.
- Climatic factors may affect birds and vector populations but they can only be fully appreciated in relation to other determinants.
- The importance of lineage 2 in the increased circulation in 2010 is not resolved. However, given the large genetic difference between lineage 1 and 2, some difference in pathogenicity, virulence, transmissibility, and ecology might be expected. Yet, this requires further study. The laboratory detection of viruses from lineage 2 in Europe needs improvement.

Treatment for WNV is not available, thus the strengthening of surveillance is needed. A surveillance system should be sensitive and able to detect WNV circulation at an early stage. The contribution of the different components (mosquitoes, birds, horses, humans) should be carefully assessed. In several countries with WNV circulation, horses will be vaccinated. Still, the use of horses in surveillance of WNV in these countries needs some re-assessment (taking into account the vaccination coverage and the duration of the immunity).

Blood donation is an issue that needs further consideration.

There is also a need for better understanding of the impact of vector control methods and strategies of WNV, taking into account the difference between rural and urban settings (e.g., urban sanitation might be useful in reducing mosquito abundance).

## 3.2 Dengue and chikungunya

Since the outbreak of chikungunya in Italy in 2007, it has been acknowledged that Europe is vulnerable to transmission of 'tropical' arboviruses. The notifications of chikungunya in France showed the transmission potential for this arbovirus in other regions where *Aedes albopictus* is present. Dengue transmission proved the vector capacity of *Aedes albopictus* in Europe, even though it has been considered a less efficient vector than *Aedes aegypti*.

The following factors seem to have played a role in the appearance of the local dengue and chikungunya transmission in Europe:

- Increased number of imported cases of dengue and chikungunya (though fewer chikungunya cases were imported in 2010 compared to 2006) due to important outbreaks in endemic countries and overseas territories.
- The geographical expansion and the increasing density of *Aedes albopictus* which is an anthropophilic mosquito and difficult to control.

It is expected that new, sporadic autochthonous cases of dengue and/or chikungunya will occur in the future. The question on how to best control this situation to avoid major outbreaks was addressed. The enhanced surveillance, for example, enabled the early detection of cases and the prompt implementation of control measures. This limited

the establishment of local transmission, though the evaluation of the surveillance system in terms of cost and effectiveness is desirable.

The following information is required to understand the transmission potential and to delineate the control options:

- defining the epidemic threshold, if any, of vector abundance below which transmission risk is limited and which can be used to guide mosquito control;
- improving the knowledge of *Aedes albopictus,* including behaviour and diapause, and on virus overwintering;
- which methods best assess adult mosquito density and biting activity;
- the impact of control methods; evaluation of the efficacy of the methods currently used; and
- developing new vector control tools adapted to an EU context.

Concern about transmission risk of other viruses (e.g. Usutu, Sindbis, or of future importation of viruses such as Saint Louis encephalitis) was also addressed.

## 3.3 Malaria

Sporadic autochthonous malaria cases occur in Europe in places where the presence of the *Anopheles* vector coincides with the import of malaria cases. Increased awareness of clinicians in MS is needed to ensure early detection and prompt treatment of cases. Risk area mapping and special attention to the situation of specific groups (e.g., migrants, which may be asymptomatic carriers) would be of value.

# 4 Conclusions, recommendations and next steps

The number of recent notifications of vector-borne diseases in the EU MS in 2010 is unusual. The current events imply the identification of new risk areas for WNV, dengue, chikungunya and malaria transmission in Europe.

The presence of WNV is well-documented in several European countries and there has been an increase in the number of cases in the EU over the past decade. Different drivers are contributing to this upsurge, but the basic knowledge required to fully appreciate the possible changing epidemiology of WNV in Europe is lacking.

The current autochthonous cases of dengue fever and chikungunya are significant public health events, and indicate that autochthonous transmission in continental Europe is possible where the vector *Aedes albopictus* is present. The widespread epidemic of dengue and chikungunya in endemic areas creates an increasing risk of importation of cases into the EU which, in combination with the increasing spread and abundance of *Aedes albopictus*, enhances the risk of autochthonous transmission.

The following is a list of recommendations:

- The risk for dengue and chikungunya, and possibly other mosquito-borne viruses, is strongly related to the presence of the vector *Aedes albopictus.* Early detection of its presence will increase the chance to control this species if effective means are available. It is recommended to strengthen the surveillance of the exotic mosquito species *Aedes albopictus* and *Aedes aegypti* in areas at risk of mosquito importation and virus transmission.
- The importation of viraemic cases increases the potential of further transmission of arboviruses such as dengue and chikungunya. Therefore, ECDC and MS epidemic intelligence activities should continue monitoring the spread of these diseases worldwide.
- Increased awareness is needed of the importation of viruses other than chikungunya and dengue (e.g., St Louis encephalitis virus) as well as other viruses transmitted in enzootic cycles (e.g., Usutu virus).
- The risk of transmission through blood, cells and tissues needs further consideration.
- The effectiveness of vector control methods applied to prevent and contain WNV and other mosquito-borne virus outbreaks is not well known. It is recommended to collate existing information and examples and make a systematic review of the potential prevention and control strategies and their impact.
- West Nile virus transmission is multi-factorial and to understand transmission different drivers related to the pathogen, the host, the vector, ecology and weather need to be taken into account. However, basic knowledge on WNV transmission is missing. Several projects addressing different aspects are ongoing or will be starting soon. It is recommended that ECDC brings together the different initiatives (e.g., EDENext, ArboZooNet, EuroWestNile) to improve coordination between these initiatives and to identify gaps of knowledge.
- Meeting participants recommended a closer association with wildlife disease specialists and ornithologists (e.g., the European Wildlife Disease Association) to study the involvement of birds in WNV transmission.
- Meeting participants expressed the need for cross-discipline awareness of the increasing potential for mosquito-borne disease transmission in the EU.

The following is a list of future actions and next steps:

- The report of the meeting will be shared.
- A West Nile virus decision tool is being developed and will be distributed for comments. Experts will be asked for their input on the tool.
- Upcoming meetings:
  - Follow-up meetings related to West Nile outbreak: January 2010, Greece, where blood safety issues will be discussed.
  - Workshop to review the tool scheduled in 2011.
  - Kick-off meetings of EDENext, EuroWestNile.
- The survey conducted by the VBORNET project will give an overview of the activities and resources in the MS related to vector-borne diseases. The first preliminary results will be presented at the Annual General Meeting scheduled in April 2011.

# Annex 1: Meeting programme

## 26 November 2010

| | |
|---|---|
| 09:00–09:15 | Opening of the meeting—scope and objectives<br>*Wim van Bortel—ECDC* |
| 09:15–09:40 | Overview of WNV, Dengue, Chikungunya and Malaria in EU in 2010<br>*Wim van Bortel—ECDC* |
| 09:40–09:55 | Drivers of the Dengue and Chikungunya transmission<br>*Paul Reiter—Institut Pasteur* |
| 09:55–10:15 | Dengue and Chikungunya outbreak in EU: the entomological perspective in France<br>*Pascal Delaunay—CHU de Nice* |
| 10:15–10:40 | Entomological drivers of the WNV transmission in EU<br>*Romeo Bellini—Centro Agricolltora Ambiente 'G.Nicoli'* |
| 10:40–11:00 | Break |
| 11:00–11:25 | Climatic trends in Europe and in the Mediterranean region in relation to West Nile Virus outbreaks<br>*Shlomit Paz—University of Haifa* |
| 11:25–11:50 | Trends in import of mosquito borne diseases: the EuroTravNet experience<br>*Philippe Parola—Hôpital Nord Marseille* |
| 11:50–13:00 | Discussion on drivers and the future risk of mosquito borne diseases in Europe |
| 13:00–14:00 | Lunch |
| 14:00–15:00 | Discussion on drivers and the future risk of mosquito borne diseases in Europe, continuation |
| 15:00–15:25 | Break |
| 15:25–16:15 | Recommended measures for preparedness |
| 16:15–16:30 | Conclusions of the meeting and next steps |

# Annex 2: Participants

| Name | Organisation | Country |
|---|---|---|
| Borislav Aleraj | Croatian National Institute of Public Health | Croatia |
| Bulent Alten | Institut de Recherche pour le développement | France |
| Romeo Bellini | Centro Agricoltura Ambiente "G.Nicoli" | Italy |
| Pascal Delaunay | CHU de Nice - Hôpital de l'Archet | France |
| Assimoula Economopoulou | Hellenic Centre for Diseases Control and Prevention | Greece |
| Philippe Malfait | Institut de Veille Sanitaire (InVS) | France |
| David Mercer | World Health Organization | |
| Yusuf Ozbel | Ege University | Turkey |
| Takis Panagiotopoulos | Hellenic Centre for Infectious Disease Control and Prevention | Greece |
| Philippe Parola | North University Hospital | France |
| Shlomit Paz | University of Haifa | Israel |
| Alexander Platonov | Central Research Institute of Epidemiology | Russia |
| Florin Popovici | Regional Centre of Public Health Bucuresti | Romania |
| Paul Reiter | Institut Pasteur | France |
| Patricia Santa Olalla | Ministry of Health, Social Policy and Equity | Spain |
| Yvan Souares | Institut de Veille Sanitaire (InVS) | France |
| Viktor Zöldi | National Center for Epidemiology | Hungary |

## Observers

| Name | Organisation |
|---|---|
| Jean-Claude Desenclos | Institut de Veille Sanitaire (InVS) |
| Henriette De Valk | Institut de Veille Sanitaire (InVS) |
| Guy La Ruche | Institut de Veille Sanitaire (InVS) |
| Paul Martin | Anses |
| Christine Saura | Institut de Veille Sanitaire (InVS) |
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