

Dynamics of autochthonous vector-borne viral diseases in Europe

Dengue in Europe

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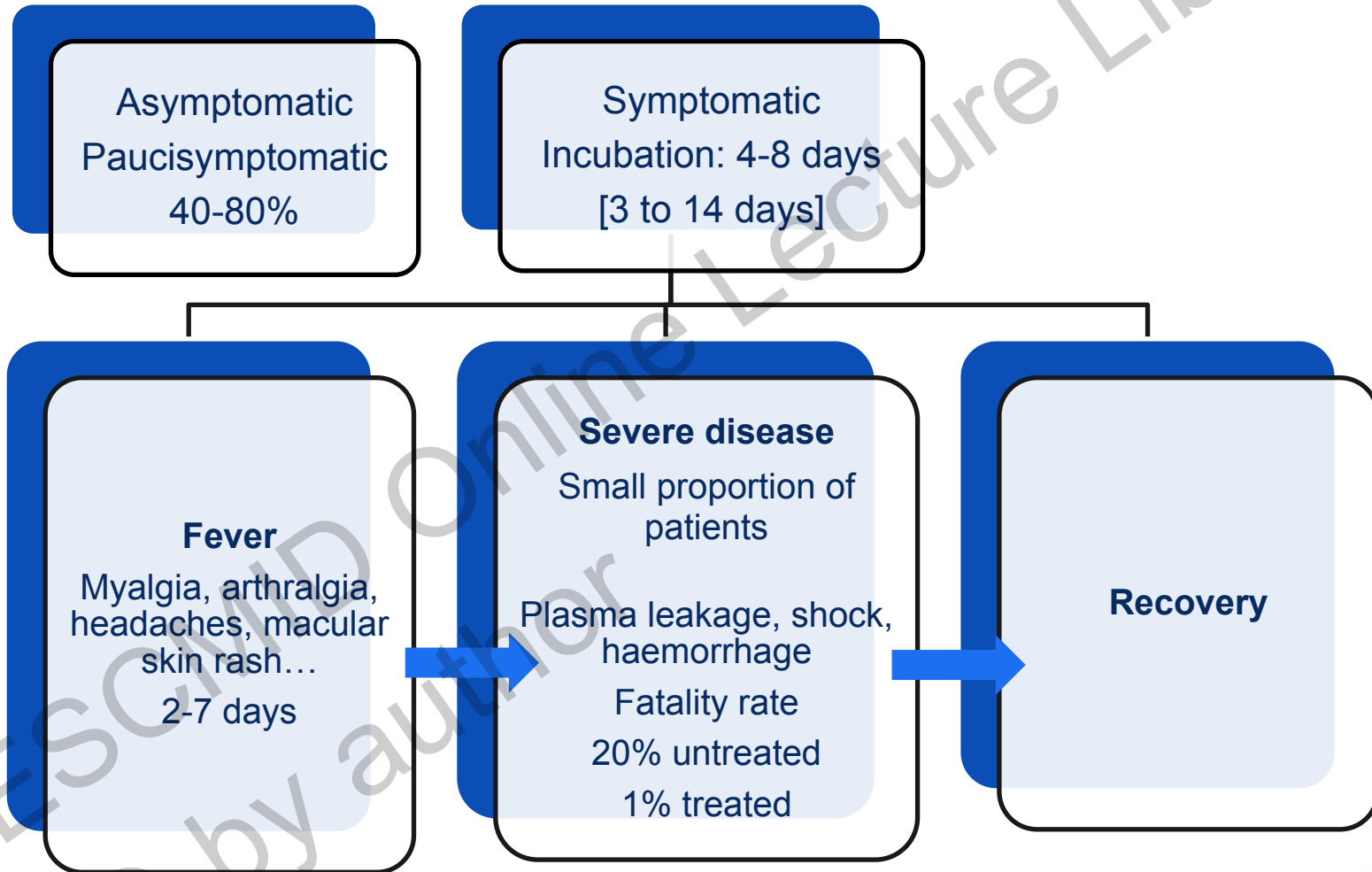
ECCMID Copenhagen, 26/04/2015

Dengue

The most widely distributed vector borne viral disease
Classically tropical and sub tropical

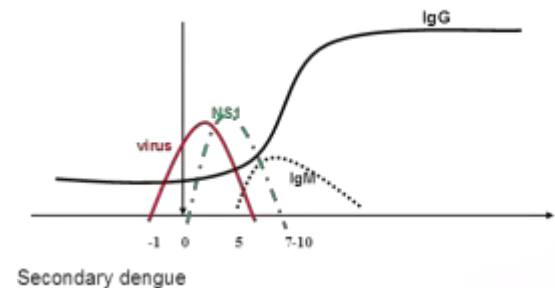
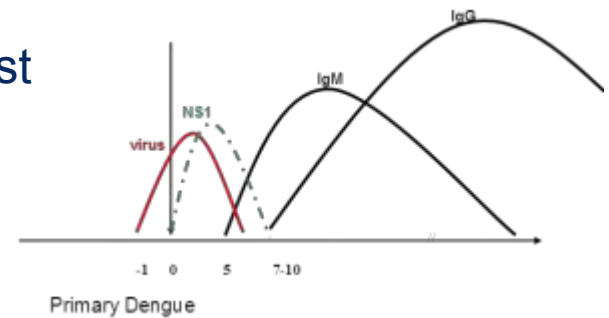


Dengue fever



Dengue viruses

- Flavivirus first isolated in 1943
- 4 serotypes (DENV-1, DENV-2, DENV-3, and DENV-4) divided into genotypes and clades
- Diagnosis
 - RT-PCR: Viraemia detectable for 4-7 days post fever onset
 - Ag NS1 : up to 9 days from fever onset
 - Antibodies - Primary infection
 - ❖ IgM: detected from day 5
 - ❖ IgG: low titre day 8-10
 - Antibodies - Secondary infection
 - ❖ IgM: can be undetectable
 - ❖ IgG: high titre soon after fever onset



Vectors of dengue: *Aedes sp.*

- *Aedes mosquitoes*
 - Urban and diurnal
 - Breed in and around houses
 - Limited flight range : 100-400m
 - Life expectancy depends on temperature : 2 - 4 weeks
 - Dengue extrinsic cycle depends on temperature : 4 -12 days



- *Aedes aegypti* : primary vector



Aedes aegypti CDC/ James Gathany

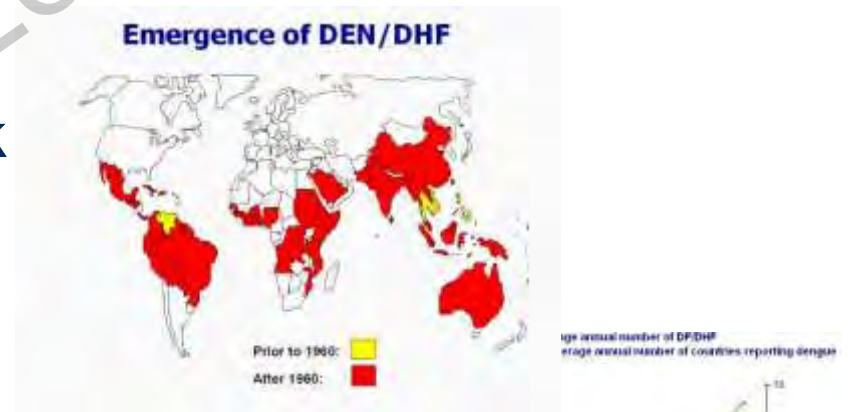
- *Aedes albopictus* : secondary vector



- Originated in Asia and spread throughout the world
- One of the 100 top invasive species

Dengue in the world

- 390 million infections worldwide in 2010
- 100 million clinically apparent/year
- 40-50% of the world's population live in areas at risk of the disease
- Dramatic increase and spread recent decades
- Burden of disease x4 in last 20 years



WHO and Bhatt (Nature, 2013)



Sources WHO,
DengueMap

Drivers for dengue transmission

- Interaction between virus, mosquitoes, people
- Environmental factors (temperature, breeding sites...)
- Socioeconomic and demographic factors
 - Population growth and urbanisation
 - Increasing movement of people
 - Increasing movement of goods and trade,
- Breakdown in public health and vector control programmes

DENGUE IN EUROPE

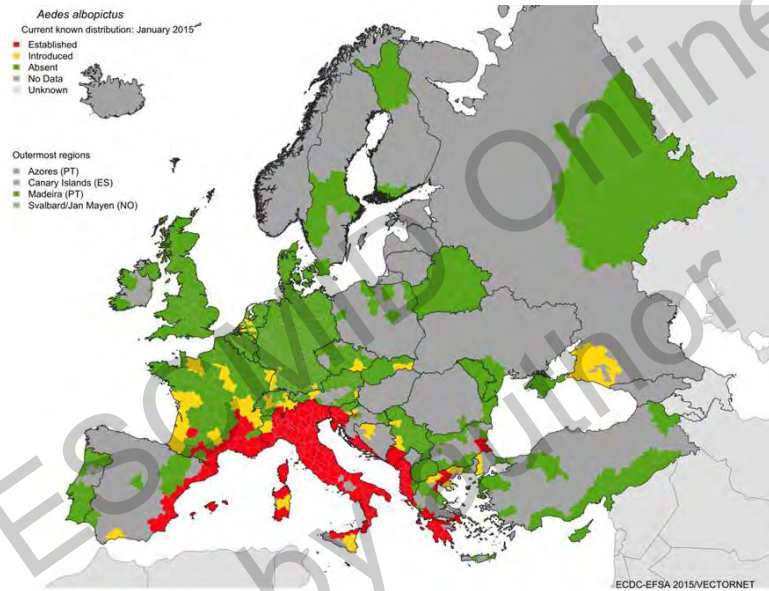
- Conditions for autochthonous transmission of dengue are met
 - Vectors establishment and spread
 - Vector / virus / human contacts
- Occurred in the past
 - Athens 1927-1928 (*Ae aegypti*)

Establishment of the vectors

Ae. Albopictus, 2015

First appearance in Albania 1979
and Italy 1990 - Constant
expansion

Activity: May - November



Ae. Aegypti, 2015

North Eastern Black Sea
Responsible for Athens epidemic
1927-1928



Ae albopictus and dengue

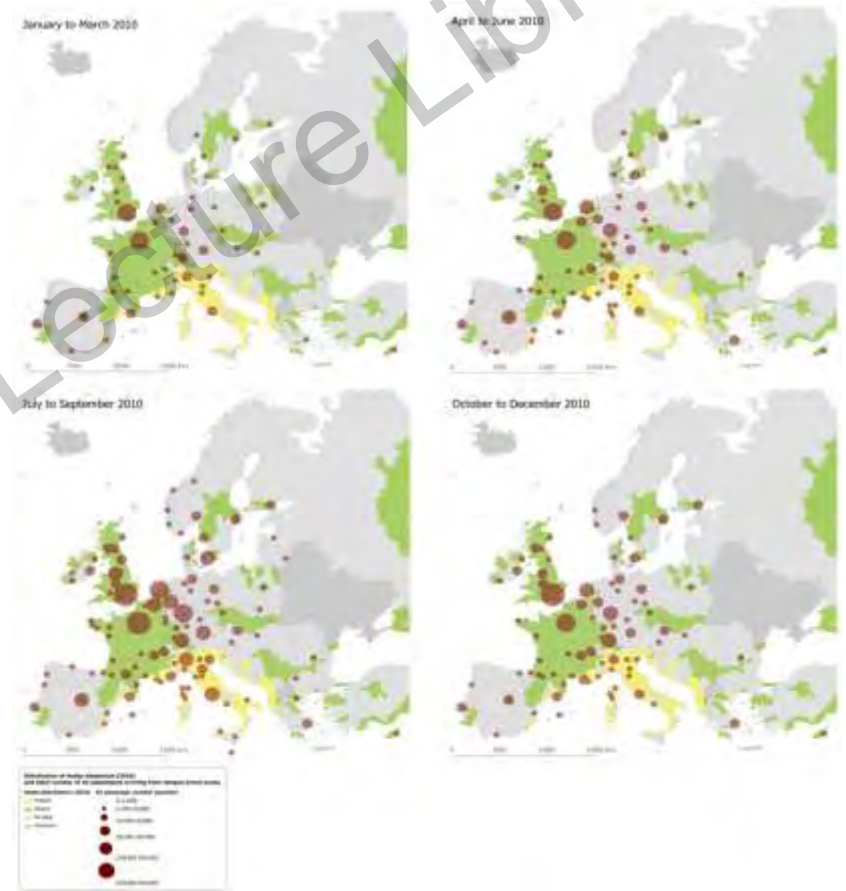
- Known vector of outbreaks of dengue
 - Japan 1942-1944
 - Seychelles 1976-77
 - La Réunion 1977, 2004, 2012
 - Gabon 2007
 - China 2004, 2010
 - Hawaii 2001-02
- Efficiency in transmitting dengue
 - *Ae. albopictus* from Nice highly efficient in transmitting dengue virus - 2010 autochthonous and imported strains (Vega Rua, PLOS One, 2013)
 - *Ae. albopictus* and *Ae. aegypti* same susceptibility to acquiring DENV infection – Vietnam strains (Whitehorn, JID 2015)

Flow of travellers into Europe

- Numerous air passengers from dengue-affected areas to Europe :

In 2010 (Semenza, PLoS Negl Trop Dis, Dec 2014)

- 5.8 million air passengers from dengue affected areas (44% Asia, 28% Latin America and Caribbean)
- 703,396 arrived in airports where *Ae. albopictus* has been recorded.
- Highest numbers : August
September
October
Monthly average
 - UK 228000
 - France 210000
 - Germany 110000



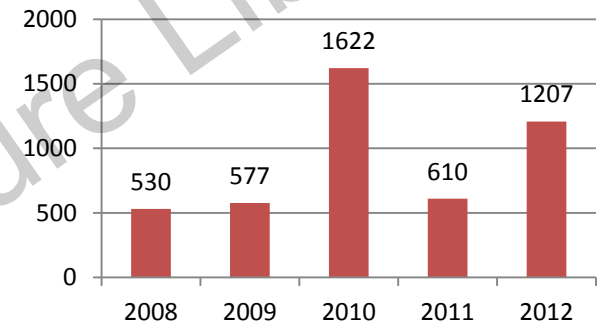
Airport-level final destination of international travellers from dengue affected areas by quarter for 2010, overlaid with the presence of *Ae. albopictus*, 2010. (Semenza, PLoS Negl Trop Dis, Dec 2014)

Imported dengue cases in Europe

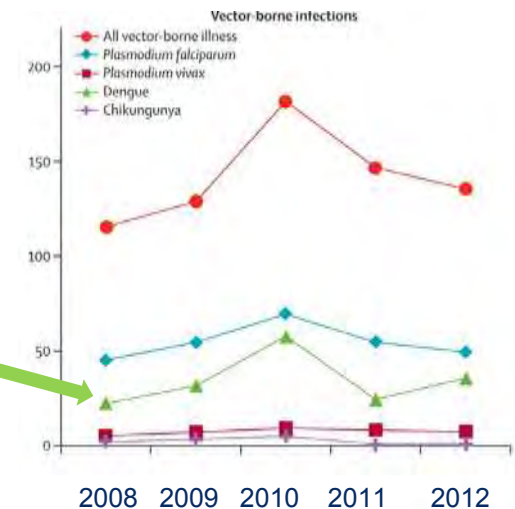
- **Highly dependent on dengue epidemiology in travellers destinations**
- **ECDC: cases notified by EU and EEA countries**
 - 2010 *major epidemics in the Caribbean.*
- **Eurotrav Net, 2008-2012**
 - Travel clinic data
 - Dengue second after malaria
 - 2009 travellers returning from the Netherlands Antilles,
 - 2010 French tourists returning from Guadeloupe and Martinique,
 - 2012 German tourists returning from Cambodia and Thailand.

Schlagenhauf, Lancet Infectious Diseases, 2015

Dengue cases notified to ECDC

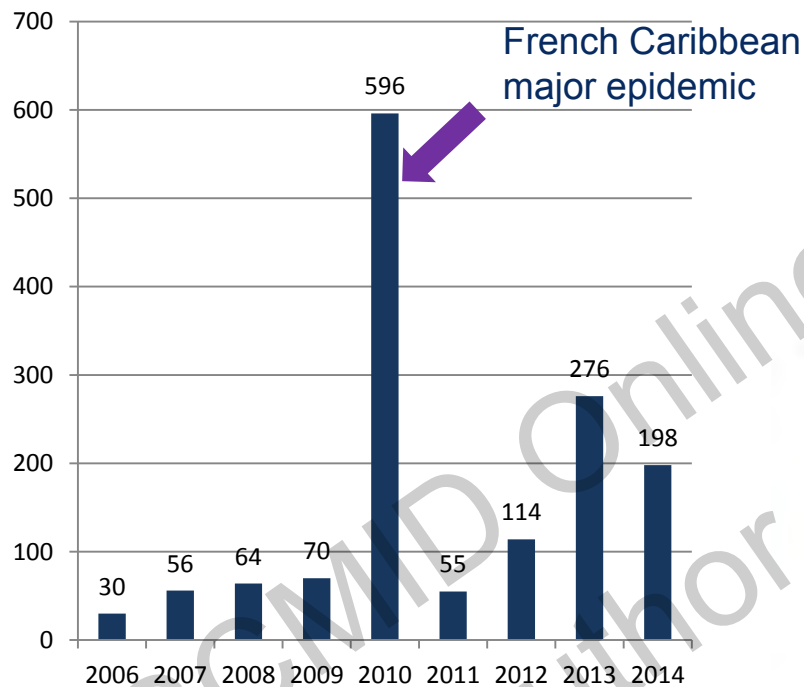


Source: Country reports from Austria, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Lithuania, Malta, Poland, Slovakia, Slovenia, Spain and Sweden.



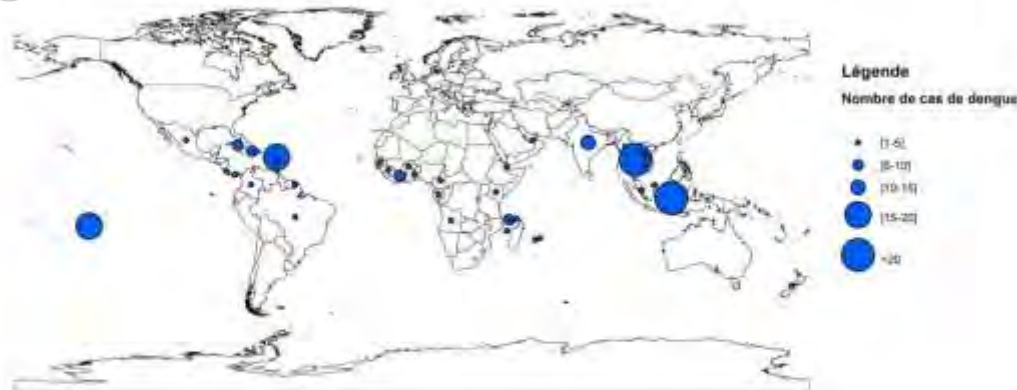
Imported dengue cases, France, 2014

Mandatory notification , 2006-14



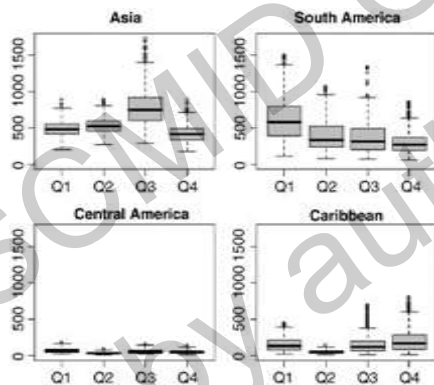
Country of acquisition, 2014

- Mainly South East Asia and French Caribbean
- Thailand: Top 3 destinations almost every year



Estimations viremic travellers to Europe

- Viremic person days among air travelers returning from endemic/epidemic countries – 2006 (Seyler, Epidemics, 2009)
 - Median : 4763 in 27 EU countries
 - Higher in the 3rd quarter of year
 - Highest from Asia in the 3rd quarter
- Estimation of imported cases from Thailand (Polwiang, J trav Med 2015)
- Infective person-days / 100,000 travelers each year
 - East Asia: 87/100 000
 - Europe: 95,5/100 000
 - North America: 103,6/100 000
- Highest numbers from June to August (rainy season in Thailand)



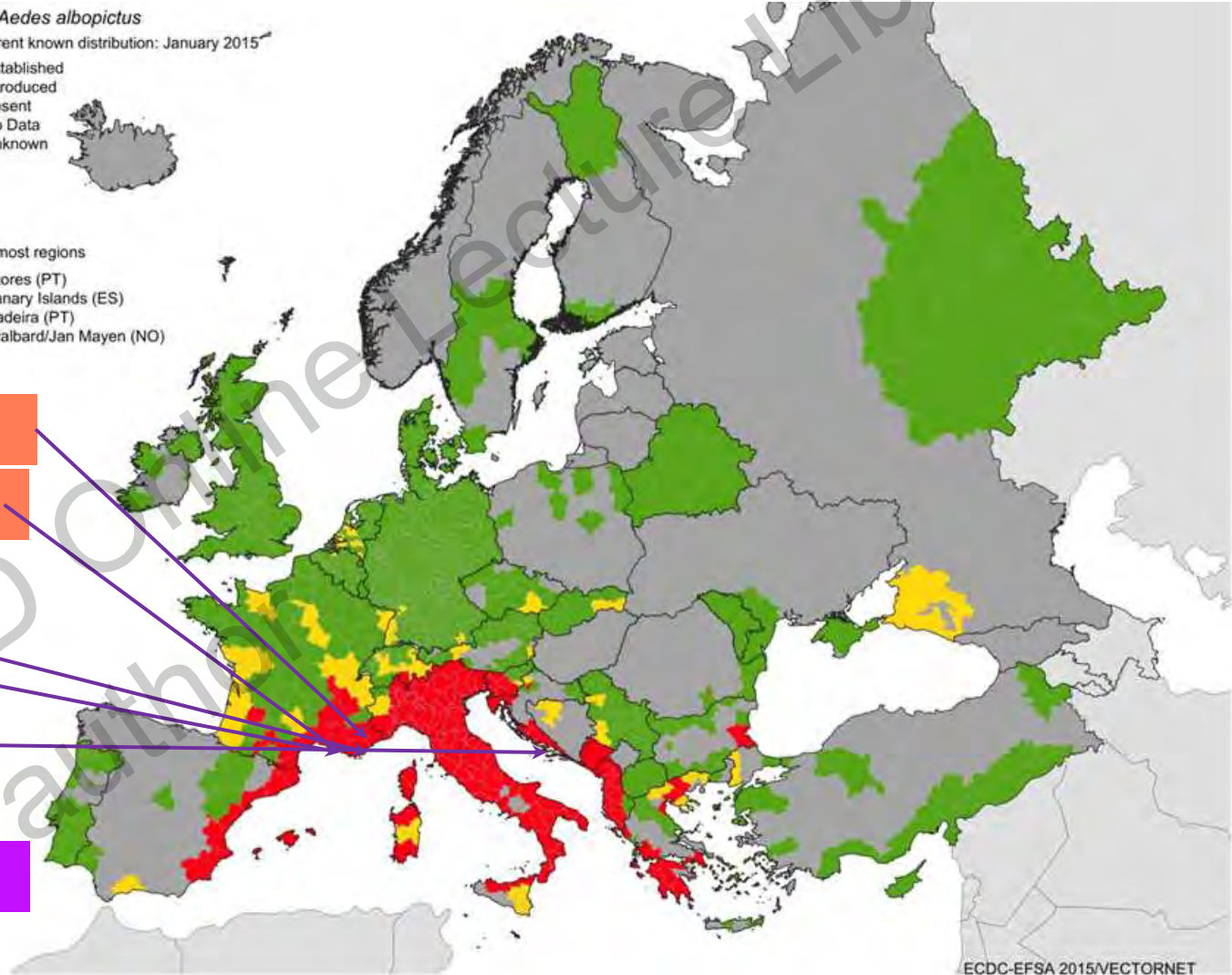
Autochthonous dengue transmission in Europe

Aedes albopictus
Current known distribution: January 2015

- Established
- Introduced
- Absent
- No Data
- Unknown

Outermost regions

- Azores (PT)
- Canary Islands (ES)
- Madeira (PT)
- Svalbard/Jan Mayen (NO)



France 2010

France 2013

France 2014

Croatia 2010

Madeira 2012-2013



ECDC-EFSA 2015/VECTORNET

Croatia, 2010

- *Aedes albopictus*
 - Established since 2004 (Zagreb)
 - Disseminated to Adriatic coast in 2006
- Sept 2010: DENV infection in a German traveller returning from Croatia
 - Symptoms 16/08/2010
 - 01-15 Aug 2010 : Pelješac peninsula and isle of Corčula
 - Diagnosis : IgM, seroconversion, Ag NS1, RT-PCR negative (D8)



Investigations in Croatia

- Active case finding : 2 additional cases in the same village
 - Symptoms 17/10/10 (IgM and seroconversion)
 - Symptoms 11/08/10 (RT-PCR : DENV1)
- Serum survey Oct-2010 : 12 recent infections (IgM +)
 - Healthy neighbours (14) :9 IgG+ including 7 IgM + ;
 - Local laboratory (Pelješac and Korčulaen) : 5/112 IgM +
- Entomological investigation, 2010
 - *Aedes albopictus* predominant
- Croatia Serosurvey Dengue 2011-12
 - 0,50% IgG positive (7/1180)
 - 2,2% seroprevalence in autochthonous cases area
 - *Aedes albopictus* prevalent species (81.37%).

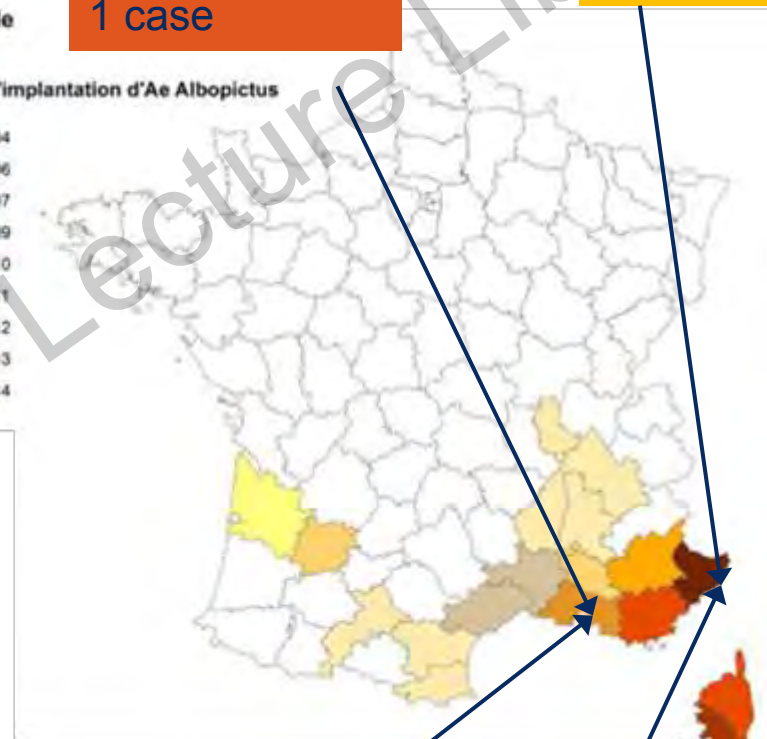


France: 2010, 2013, 2014

- *Ae. Albopictus*
 - Established and spreading since 2004
 - Active May to November
- Contingency plan since 2006
 - Implemented May-November
 - Enhanced surveillance of human cases
 - Vector surveillance
 - Prevention and control
- Detection of 5 limited episodes
- Implementation of control measures

Légende

Année d'implantation d'*Ae. Albopictus*



Aix, Oct 2013
1 case

Nice, Sept 2010
2 cases

Aubagne,
Aug – Sept 2014
2 cases

Toulon Aug 2014
1 case

Toulon Sept 2014
1 case

Nice, Aug-Sept 2010 : 2 cases

- *Ae. albopictus* established since 2005
- 2010: Major dengue outbreak in French Caribbean islands
- Case 1 => Active case finding and vector control measures => Case 2
- Two potential index cases : imported cases in the neighbourhood returning from Martinique
- DENV 1 similar to strain circulating in Martinique
- No more case after control measures

Case 2
Symptoms : 11/09/10
Through active case finding
DENV1 (RT-PCR)

Case 1
Symptoms : 23/08/10
Notified 10/09,
DENV1 (RT-PCR)



Imported case(ii)
return: 20/07/10
Symptoms : 21/07/10
Distance : 396 m

Imported case(i)
Return: 21/07/10
Symptoms: 19/07/2010
Distance : 180 m

Aix en Provence, Oct 2013 : 1 case

- *Ae. albopictus* established since 2009
- Symptoms 11/10/13
- Diagnosis 24/10/20:
 - ◆ RT-PCR: dengue positive
 - ◆ Serology: seroneutralisation DENV 2
- Investigation
 - ◆ Mosquito bites near work on 3/10
 - ◆ No mosquitoes at home
 - ◆ Probable index case returning from Guadeloupe, short visit close to case work place
- Vector control measures – end of mosquito season
- No more case

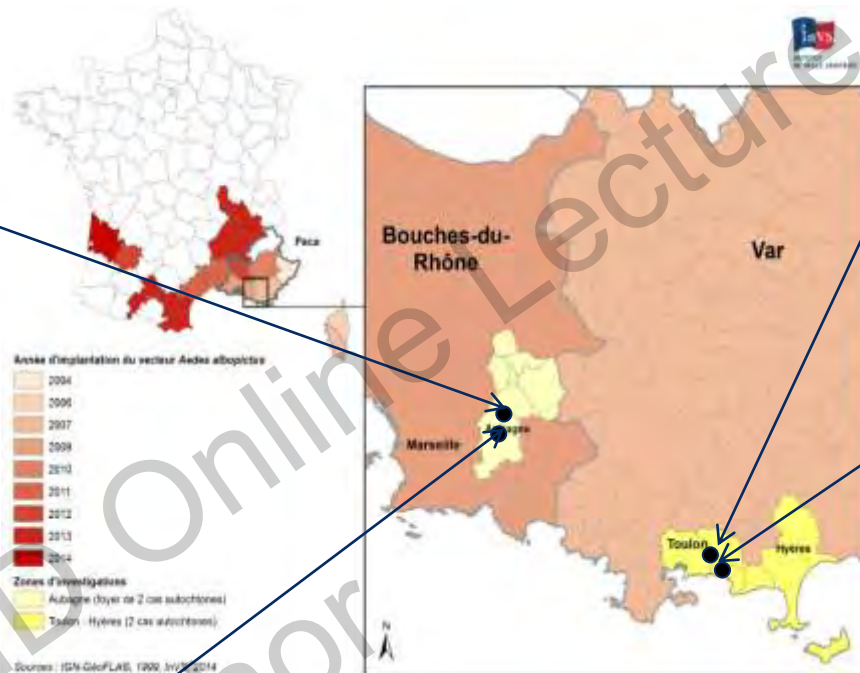


2014, Provence Alpes Cote d'Azur: 4 cases

AUBAGNE: cluster of 2 cases

24/08/14: case A
DENV2
Index case:
family member
(dengue
contracted
Thailand)

19/09/14: case B
DENV2
Case A
neighbour



**TOULON HYERES
2 cases**

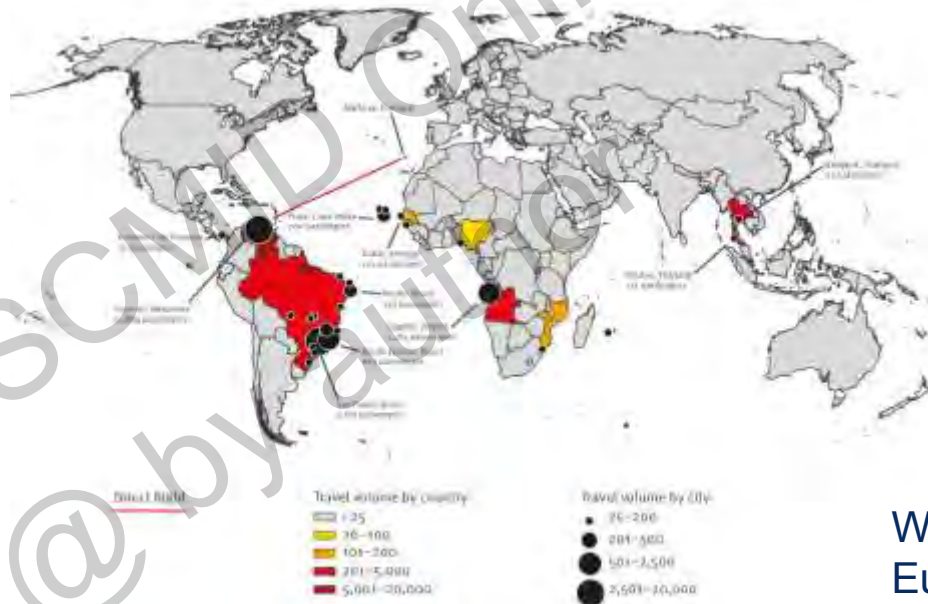
05/08/14: case 1
DENV1
Unknown index case

03/09/14: case 2
DENV2
Unknown index case

2012, Madeira (Portugal)

- Island 1000 km from continental Europe, central Morocco latitude
- Temperate Mediterranean climate (15°C winter – 25°C summer)
- Population : 270 000, half in Funchal
- *Ae. aegypti* eradicated before 1977 and re-established in 2005
- Tourist destination (peaks Easter and August – September)

Map of air travel volume by country and city from dengue endemic countries to Madeira, 2012

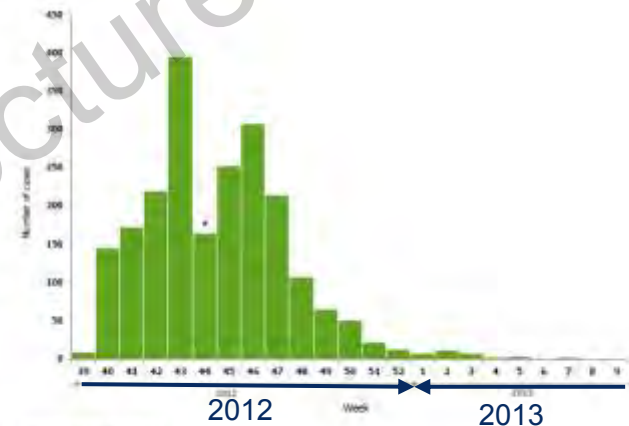


Wilder-Smith,
Eurosurveillance, 2014

2012-13, Madeira

- 03/10/12 : 2 dengue autochthonous cases laboratory confirmed : DENV1
- Symptoms: 20 and 27/09/12
- 3 March 2013: Of 2 168 probable cases, 1080 confirmed.
 - ◆ Peak in November
 - ◆ Sharp decrease with winter temperatures
 - ◆ Outbreak declared stopped in March 2013
 - ◆ No resurgence since
- ECDC survey: 81 cases exported to continental Europe (11 in Portugal)

Dengue cases (probable and confirmed by week, weeks 39/2012 to 9/2013), Autonomous region of Madeira



* Introduction of MOSS

Figure 3: Cumulative incidence rate for probable and confirmed dengue cases per 10 000 inhabitants, by parish of residence, weeks 39/2012 to 9/2013, Madeira Island



Source: DASAÚDE; discretisation method: natural break (Jenks); map projection: EPSG:3061 - Porto Santo/UTM zone 28W; software: Quantum GIS 1.8; map reference: ECDC_CIR_12168

Source ECDC

Origins of Madeira epidemic

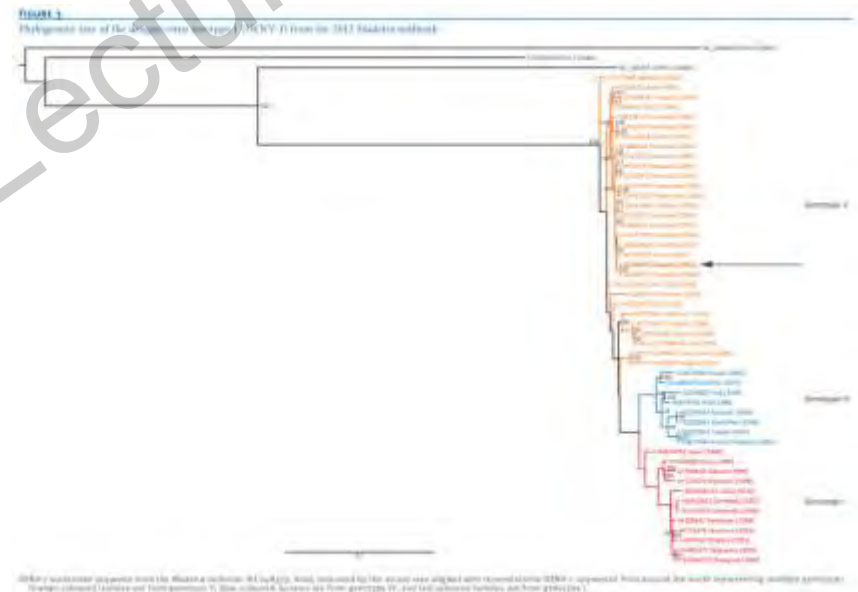
- Strain most probably from Venezuela

Wilder-Smith, Eurosurveillance 2012;

Huhtamo, Eurosurveillance 2012

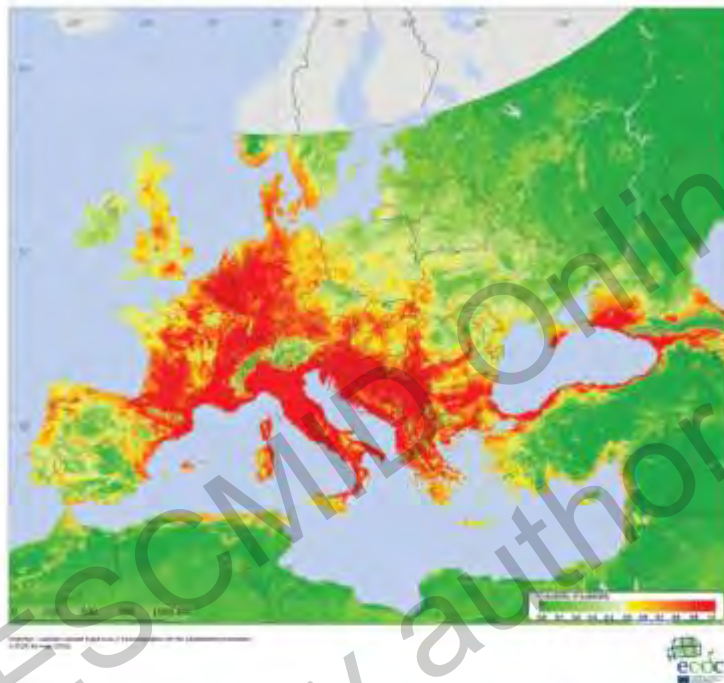
- Possible introduction end of August

Lourenço, PLOS NTD, 2014



Prospects for the future in Europe

Climatic suitability for *Ae. albopictus* (ECDC)



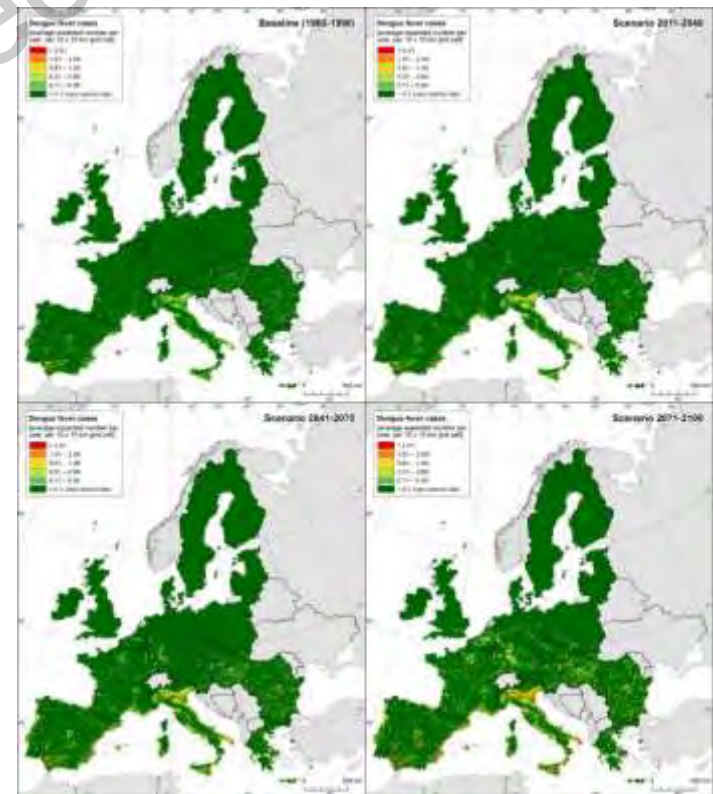
Note: This map was produced by combining the outputs of all the *Ae. albopictus* models using a non-linear discriminant analysis. The probability scale is from zero to 1.0.

Probabilities from [0–0.49] are coloured green (darker to lighter) and indicate conditions not suitable for the vector (or gradual predicted absence of the vector).

Probabilities from [0.5–1] are coloured yellow through to red, indicating conditions increasingly suitable for the vector (or gradual predicted presence of the vector).

Future dengue risk

- Not major but likely to increase mainly on Mediterranean and Adriatic coasts (Bouzid, BMC Public Health, 2014)



Conclusion (1)

- Conditions for transmission of dengue are met in Southern Europe
- Autochthonous cases detected once in Croatia and several episodes identified in France (role of enhanced surveillance?)
- Undetected self limited episodes may have occurred
- Greater risk : August – October
- Repeated occurrences of transmission are likely in the future
- Winter in temperate climate countries favours extinction of transmission

Conclusion (2)- Recommendations

- Support the fight against dengue in the world
- Awareness of travelers about the risk of contracting dengue and prevention measures
- Physicians to consider the diagnosis of dengue (and chikungunya) for patients living or having stayed in European areas where the vectors are present
- Prevention and control of vector borne diseases should be on the agenda of public health in European countries
 - ECDC is coordinating such work at the European level
 - Early detection of infectious dengue (and chikungunya) patients allows implementation of appropriate vector and disease control measures.

Thank you for your attention

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