



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport



Prevention and future
perspectives for
Europe

Vector control strategies

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Vector control strategies | 09-03-2016



National Institute for Public Health
and the Environment
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Contents

1. Vectors
2. Vector Control
 - o Ticks
 - o Mosquitoes
3. Zika vs West Nile vector control

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1. Vectors

3

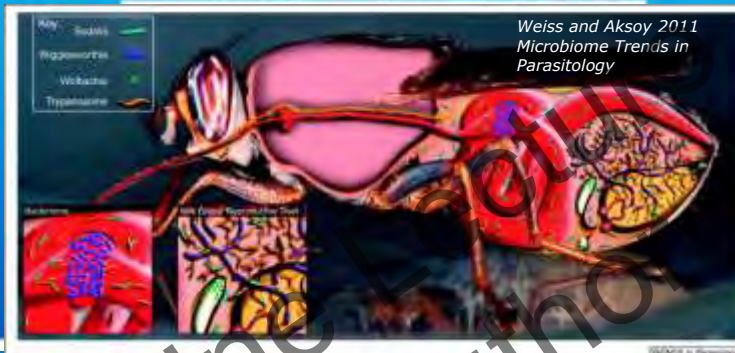
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	Bacteria	Virus	Protozoa	Filaria
Ticks				
Sand flies				
Mosquitoes				
Biting midges				

WHEN THE VECTOR IS A GOOD ONE ?

Bellini pdf 2012

- ✓ the vector and the disease have the same distribution
- ✓ the hosts preference of the vector is compatible
- ✓ the vectorial competence has been proven experimentally
- ✓ the species has been found infected in nature



Disease
Afebrile leucopenia
African Horse sickness
African Swine fever
AINO disease
Akabane disease
Alkhurma hemorrhagic fever
Bhanja virus disease
Bluetongue
Bovine ephemeral fever
Cache Valley virus
Chuzan disease
Crimean Congo hemorrhagic fever
Eastern Equine encephalitis
Epizootic hemorrhagic disease (including Ibaraki)
Equine encephalosis
Getah virus
Heartwater - Cowdriosis
Hepatozoonosis
Highland J virus
Japanese encephalitis
Kotonkan virus
Leishmaniasis
Main Drain virus
Middelburg virus
Nairobi Sheep disease / Ganjam virus
Peruvian Horse sickness
Rift Valley fever
Schmallenberg virus
Semliki forest virus
Shuni virus
St. Louis encephalitis
Venezuelan Equine encephalitis
Vesicular stomatitis - Alagoas virus
Vesicular stomatitis - Cocal virus
Vesicular stomatitis - Indiana virus
Vesicular stomatitis - New Jersey virus
Wesselsbron virus
West Nile fever
Western Equine encephalitis
Yunnan virus

Disease list:

Vector-borne diseases of veterinary interest for Europe.

Selected by EFSA

Analysed by **VectorNet**

38 VIRUSES and 3 bacteria and 1 protozoa

World wide:

645 unique pathogen-vector species combinations

In the **VectorNet area**



Disease	Ticks	Sand flies	Biting midges	Mosquitoes	Total
Afebrile leucopenia	2				2
African Horse sickness			3		3
African Swine fever	1				1
AIPO disease			1	2	3
Akabane disease			2	2	4
Bhanja virus disease	7				7
Bluetongue			12		12
Bovine ephemeral fever			2		2
Cache Valley virus				5	5
Crimean Congo haemorrhagic fever	11				11
Eastern Equine encephalitis				6	6
Epizootic haemorrhagic disease (including Ibaraki)			10		10
Equine encephalosis			1		1
Getah virus				5	5
Hepatozoonosis	1				1

VectorNet area:

168 unique pathogen-vector species combinations

Nairobi sheep disease / Ganjam virus			1	1
Rift Valley fever			17	17
Schmallenberg virus		8		8
Semliki forest virus			1	1
Shuni virus			1	1
St. Louis encephalitis			2	2
Venezuelan equine encephalitis			2	2
West Nile fever			22	22
Western equine encephalitis			2	2
Yersinia virus			1	1

	Bacteria	Virus	Protozoa	Filaria
Ticks	✓	✓	✓	
Sand flies		✓	✓	
Mosquitoes		✓	✓	✓
Biting midges		✓		

**INTERVENTION:
In context**

Context	Disease Burden	Pathogen	Vector	Vector Intervention
1	v	v	v	
2	-	v	v	
3	-	-	v	
4	-	v	-	
5	-	-	-	

**INTERVENTION:
In context**

	Controlling vector			
Control Vector	Transmission interruption	Elimination invasives	Population management	Exposure control
Ticks				
Sand flies				
Mosquitoes				
Biting midges				



2. Vector control

1. Ticks

11

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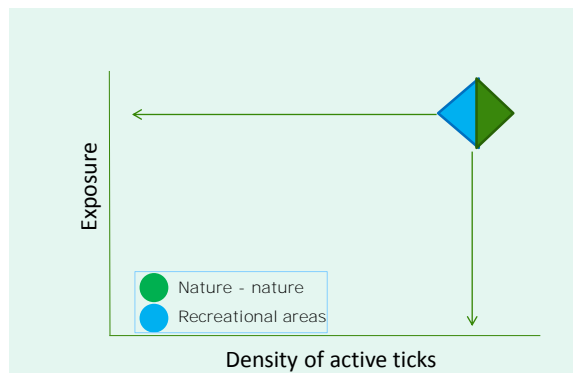
Lyme prevention



Risk is the **chance** on contracting **Lyme disease**

Risk is the **exposure** to (infected) **ticks**

Reduction of Risk by reduction of the **exposure** or the number of (infected) **ticks**



Risk reduction

=
hazard and exposure reduction



Tick control	
	Forest management
	Grazing
	Wild fauna management
	<i>Sheep mopping</i>
	Biocidal measures
	Tick vaccines
Exposure	
	Personal protection
	Self-effectivity
	Societal involvement
	Nature conservation involvement
	Projections in place (maps)
	Predictions in time (weather)
	Prophylactic actions
	Pet protection

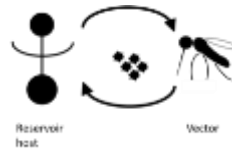
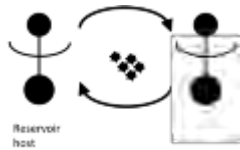
13

2. Vector control

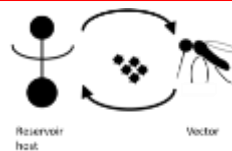
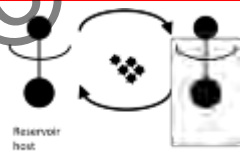
1. Ticks
2. Mosquitoes

14

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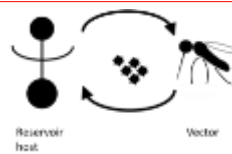


15



Prevention			
Observation			
Intervention			

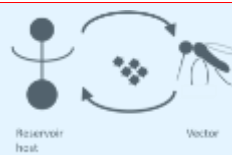
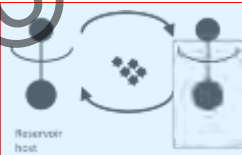
16



Prevention	○ Vaccination	
Observation	○ Surveillance human cases	
Intervention	○ Curative medicines	

17

Aedes mosquito: Out of Control? | 29 January 2015



Prevention	○ Vaccination	○ Vaccination
Observation	○ Surveillance human cases	○ Surveillance human cases
Intervention	○ Curative medicines	○ Curative medicines

18

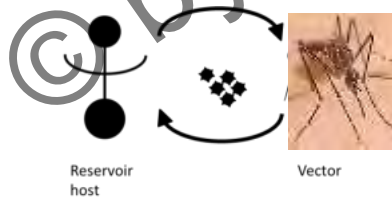


3. Zika vs West Nile vector control

19

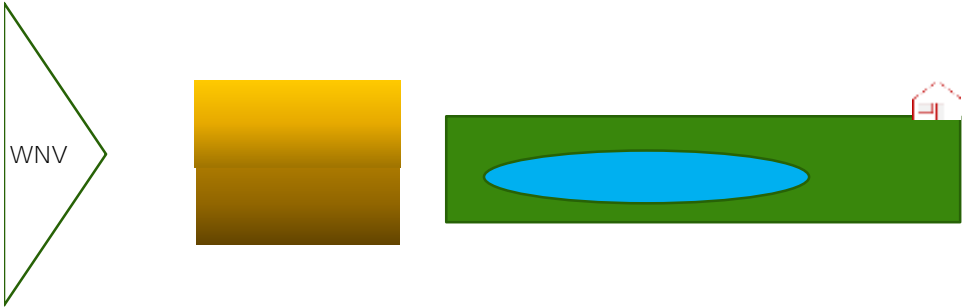
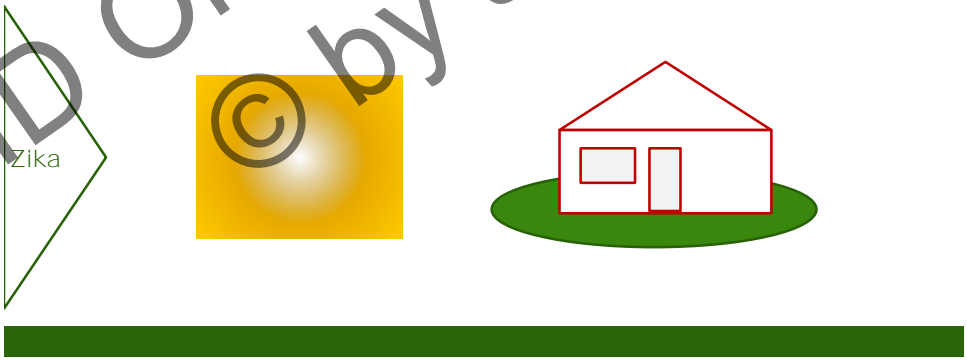
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Zika

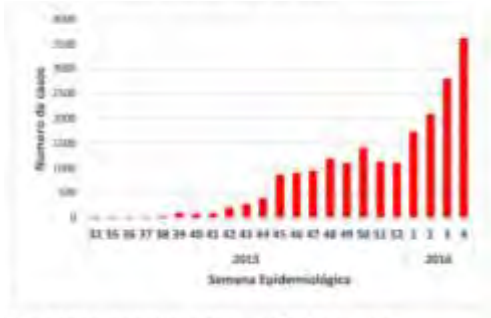


WNV

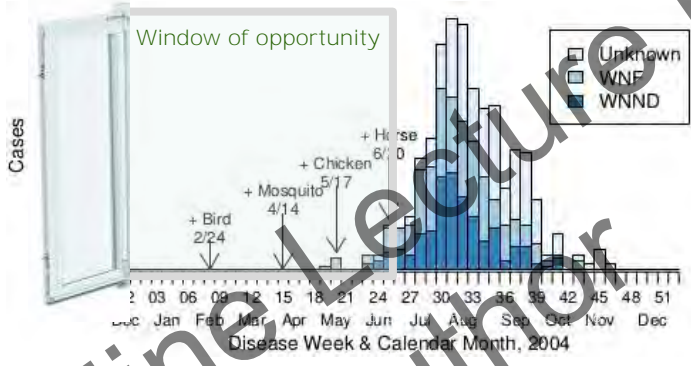




Zika



WNV



Zika

- | | | |
|--------------|---|--|
| Prevention | o Source reduction | 1) Multiple man-made and natural sources |
| | o Larval control | 2) Requires good planning and resources |
| Observation | o Survey Eggs | 3) Requires community participation |
| | o Larvae | 4) Requires continuous execution |
| Intervention | o Adults | 5) Requires general execution, not focal |
| | o Adult control / fogging | |
| | o Repelents, protective clothing, airconditioning, bed nets | |



Prevention

- Source reduction
- Larval control

Observation

- Survey Eggs
- Larvae
- Adults

Intervention

- Adult control / fogging
- Repelents, protective clothing, airconditioning, bed nets



→ **Adult control:** NB in outbreaks not in prevention phase!

- Chemical control
 - Indoor residual spraying
 - Intra-domiciliary spatial spraying
 - Focal spatial spraying
 - Spatial spraying of resting and breeding sites





Prevention

- Source reduction
- Larval control

Observation

- Survey Eggs
- Larvae
- Adults

Intervention

- Adult control / fogging
- Repelents, protective clothing, airconditioning, bed nets

- 1) Low effectivity (mosquitoes indoors)
- 2) Requires good planning and resources
- 3) Induces insecticide-resistance



Prevention

- Source reduction
- Larval control

Observation

- Survey Eggs
- Larvae
- Adults

Intervention

- Adult control / fogging
- Repelents, protective clothing, airconditioning, bed nets

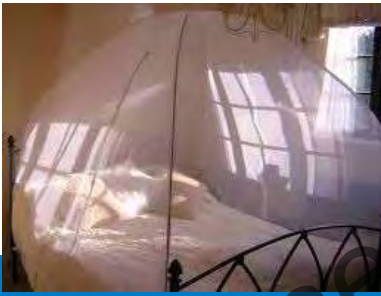


Zika WNV

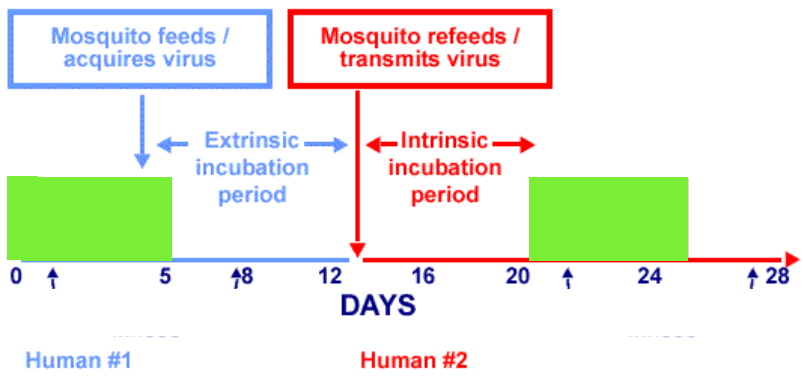


Interruption transmission
 Protection against mosquito bites essential for

- Healthy people
- Asymptomatic viremic persons (20-40%)
- Viremic patients (recently fallen ill)



Zika



Duong et al 2015 PNAS
 Asymptomatic humans transmit dengue virus to mosquitoes

Transmission without symptoms

Prevention

- Source reduction
- Larval control

Observation

- Survey Eggs
- Larvae
- Adults

Intervention

- Adult control / fogging
- Repelents, protective clothing, airconditioning, bed nets

- 1) Requires continuous implementation
- 2) Issues with viremic asymptomatics

INNOVATIONS	
Prevention	<ul style="list-style-type: none"> ○ Control vector population ○ Mass trapping ○ Genetic modified mosquitoes ○ New insecticides
Observation	<ul style="list-style-type: none"> ○ Surveillance vectors
Intervention	<ul style="list-style-type: none"> ○ Transmission interruption ○ Exposure reduction ○ New insecticides

BUT the real solution



33



Take home message:

- "Not all blood feeding arthropods are vectors"
 - E.g. 3500 species of mosquitoes in the world, 35 species native to NL, few potential vectors
- There is nothing EASY about vector control
 - solutions can only be achieved multidisciplinary collaboration (societal, political, scientific)

34

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Thanks to

- Romeo Bellini
- Francis Schaffner
- Aleksandra Chaskapoulou

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