



DIPARTIMENTO
MALATTIE INFETTIVE

Scaling up of national systems for vector threat detection and control capacities (HERA)

Giulietta Venturi, Claudia Fortuna, Marco Di Luca, Patrizio Pezzotti



www.iss.it/malattie-infettive



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Financing of the programme for the Union's action in the field of health ('EU4Health programme') and the adoption of the work programme for 2025

CRISIS PREPAREDENESS (CP)

CP-g-25-02 Direct grants to Member States' authorities for the scaling up of national systems for vector threat detection and control capacities (HERA)

Obiettivi

- scale up capacities by developing and/or enhancing national vector threat detection systems and improving vector control programmes;
- aligning with broader Union health and environmental goals to protect public health and address the risks posed by vector borne diseases and more generally the impacts of climate change;
- assess the effectiveness of these vectors in transmitting and spreading exotic diseases across Europe; and
- bolster laboratory capabilities for monitoring insecticide resistance in vectors.

Istituto Superiore di Sanità



Founded in 1934
for the fight against malaria...

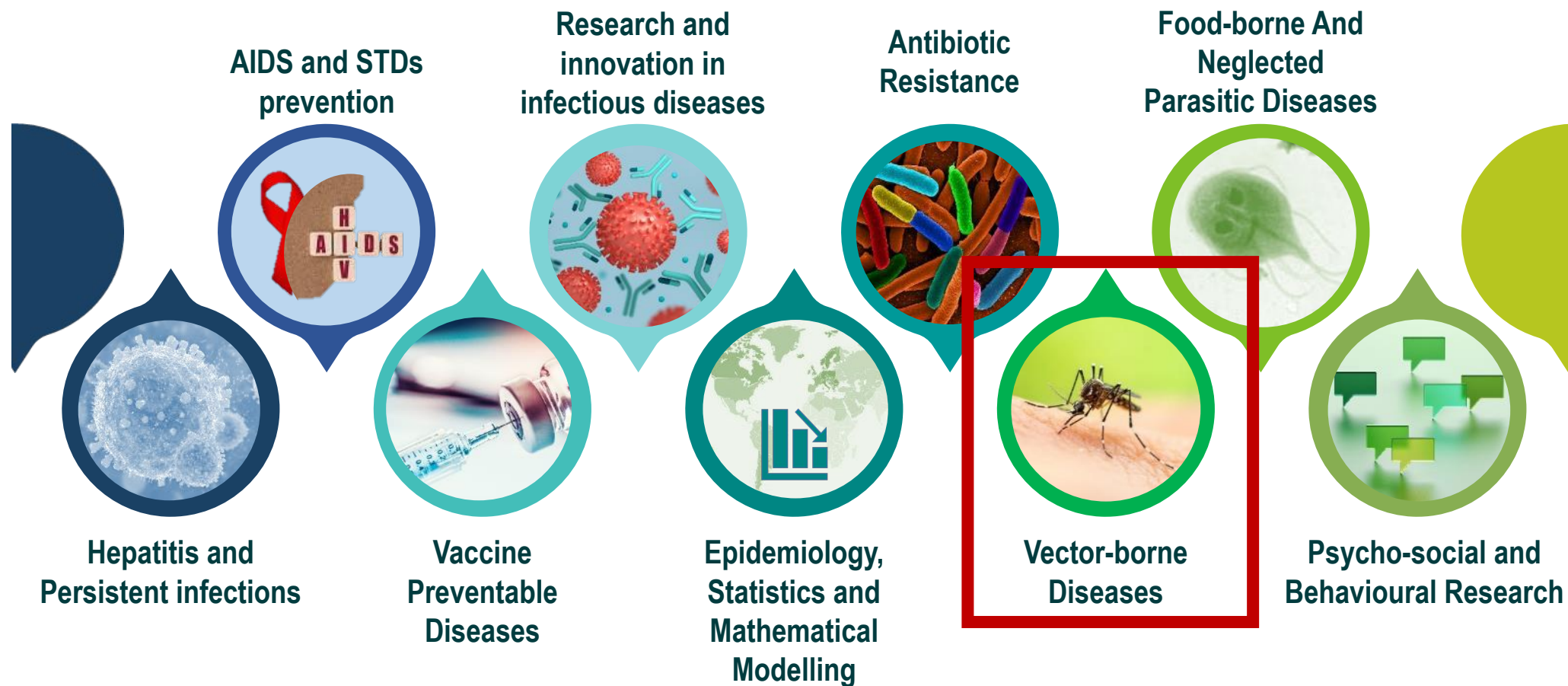
Is the main
Research institute for
Public health
in Italy

technical and scientific body of the
Italian National Health Service



ISS - Department of Infectious Diseases

9 Units for Research and Public Health



in collaborazione con CNS, CNT, CENSIA, SANV, Global Health (ISS); Ministero della Salute; AIFA; AGENAS, ISTAT, ECDC, WHO, ...

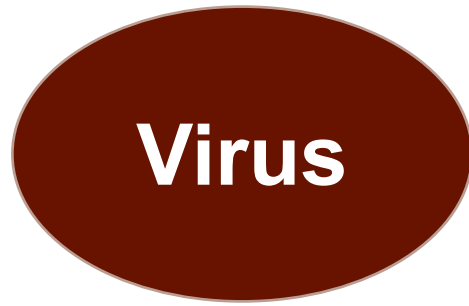
Patologie umane causate da parassiti, virus e batteri trasmesse da ospiti invertebrati quali zanzare, flebotomi, zecche, simulidi, pulci, pidocchi, ecc. OMS

*Cosa sono le
malattie trasmesse
da vettori?*

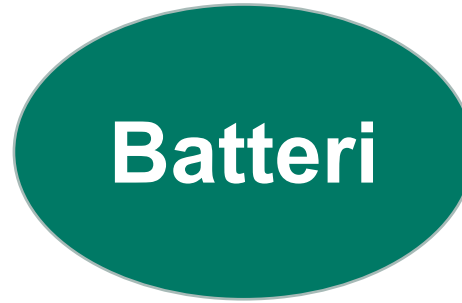


Cosa sono le malattie trasmesse da vettori?

Patogeni diversi che condividono una via di trasmissione



Arbovirosi



Es. Rickettsie e
Borrelie



Es. Malaria, Leishmania,
Filaria

Perchè sono importanti?

- Diffuse a livello globale con un impatto elevato sulla salute umana (OMS)
 - **Le principali malattie trasmesse da vettori costituiscono insieme il 17% di tutte le malattie infettive a livello globale.**
 - **Ogni anno si stimano globalmente oltre 700 000 decessi associati a patologie trasmesse da vettore.**
 - **L'impatto di queste patologie è maggiore in zone tropicali e sub-tropicali ed è maggiore nelle popolazioni più povere.**

Malattie trasmesse da vettori: malattie emergenti?

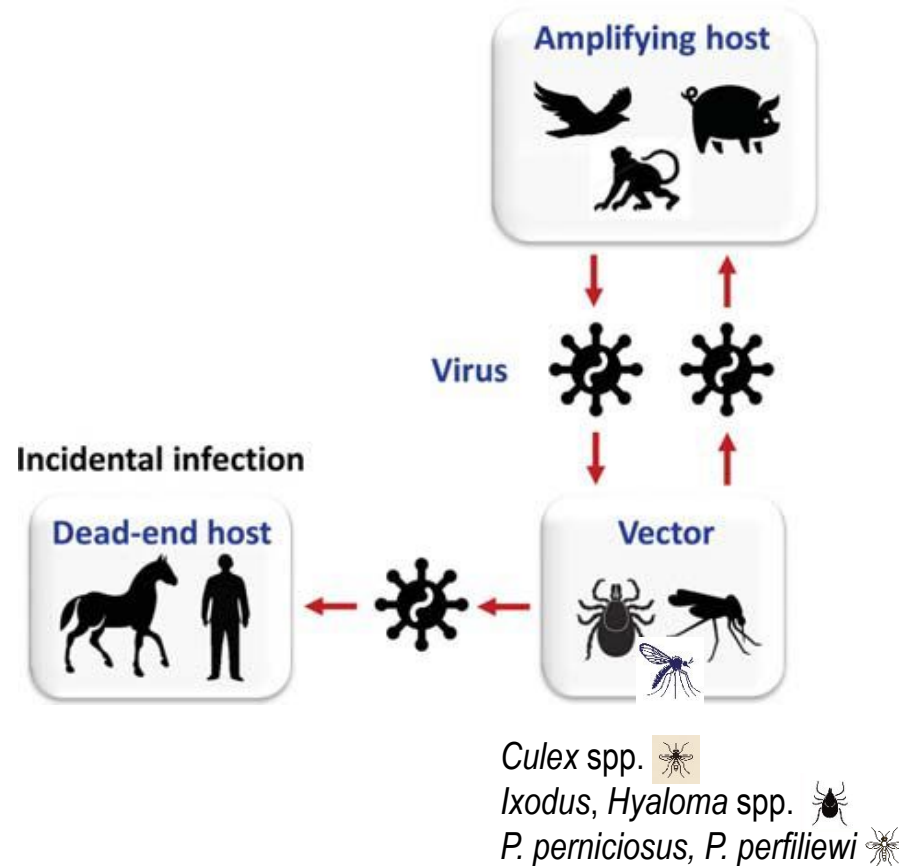
- Includono patogeni la cui epidemiologia è in rapido cambiamento in Italia ed Europa
- Diffusione e intensità di trasmissione fortemente influenzate da fattori climatico-ambientali

Un quadro di insieme: situazione in Europa continentale (temperata)

Enzootic/epizootic cycle

Viruses:

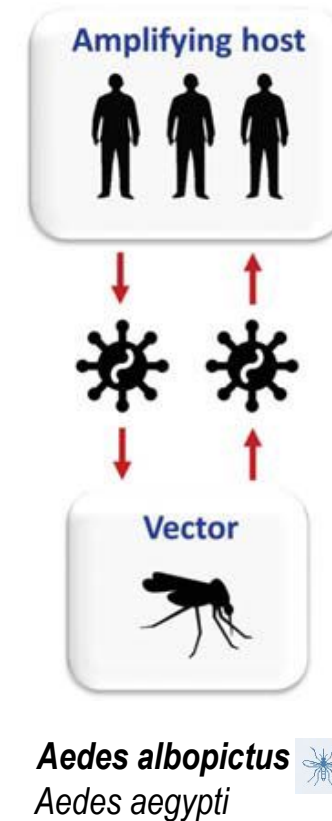
WNV West Nile **JEV** Japanese encephalitis
TBEV Tick-borne encephalitis **TOSV** Toscana
CCHV Crimean-Congo Haemorrhagic Fever



Urban epidemic cycle

Viruses:

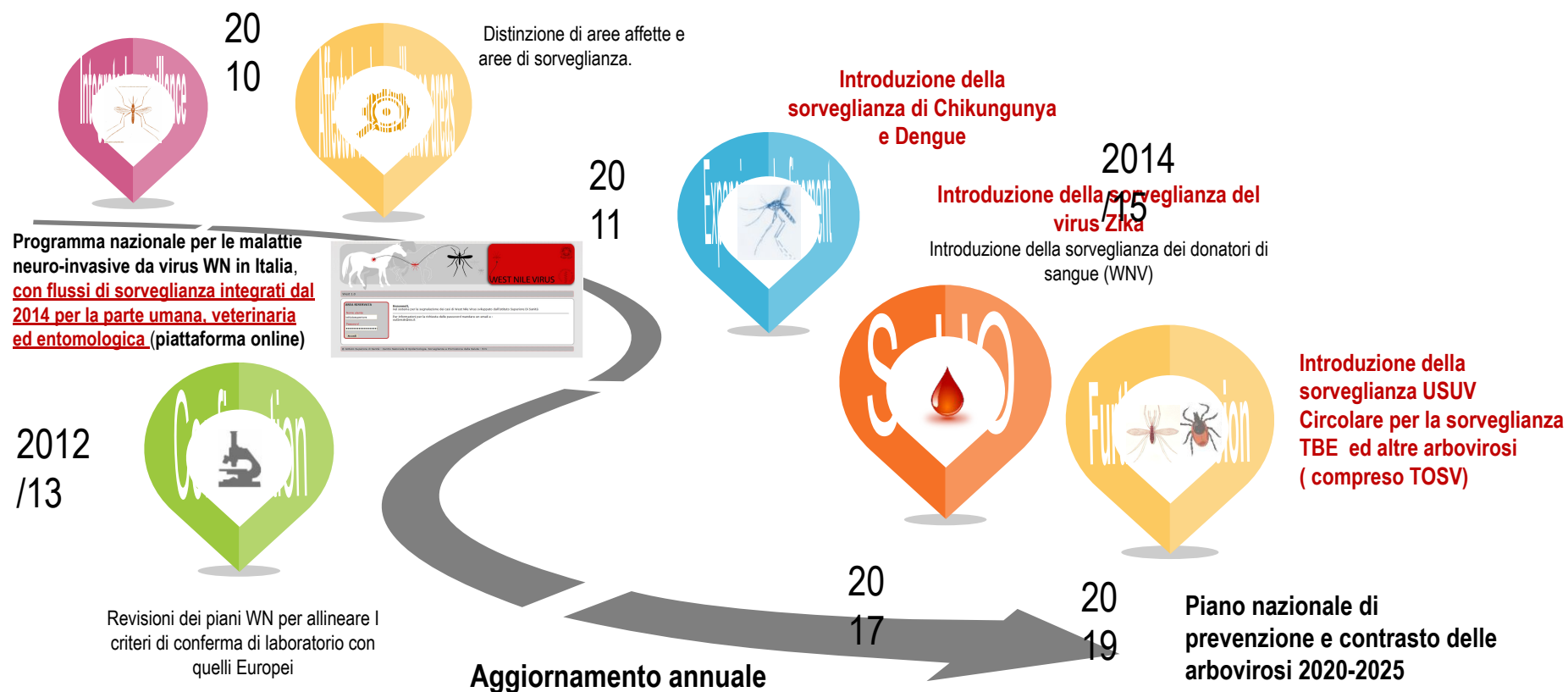
DENV Dengue **YFV** Yellow Fever
CHIKV Chikungunya **ZIKV** Zika



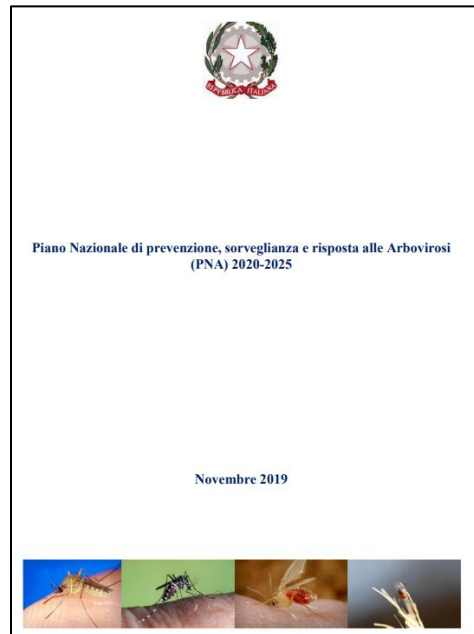
Tappe nella diffusione delle arbovirosi nel mondo e in Italia



Sviluppo di un approccio integrato di monitoraggio e al contrasto delle arbovirosi



The Italian National Plan for Prevention, Surveillance and Response to Arboviruses (PNA) 2020-2025



One-health approach!
human, veterinary and
entomological aspects are
covered



PNA 2020-2025

The **main objective** of surveillance is the timely identification of imported and autochthonous disease cases, to undertake a series of measures to reduce the risk of transmission of the virus.

The PNA applies to:

- Surveillance and response to arboviruses, with a particular attention to:
 - ✓ **West Nile and Usutu viruses**
 - ✓ arboviruses transmitted by invasive mosquitoes (*Aedes* sp.), such as **Chikungunya, Dengue, and Zika viruses** – including the monitoring of congenital syndrome
 - ✓ **Tick-born encephalitis virus (TBEV) and Toscana virus.**
- Surveillance of invasive mosquitoes
- Monitoring of resistance to insecticides

National Plan for Prevention, Surveillance and Response to Arboviruses (PNA) 2020-2025

The PNA gives indication on:

- Case definition, including laboratory criteria
- Information flows for notification of cases
- Algorithms for laboratory investigations on suspected cases, and for confirmation of cases
- Detailed indication for implementation of vector control measures
- Measures to prevent transmission through blood donations and blood components, organs and tissues

PNA 2020-2025: Surveillance and response to West Nile virus and Usutu virus

The national territory is subdivided into risk areas (high, low, minimum) based on the evidences of viral circulation in the previous 5 years, and on ecological and environmental information.

1. Surveillance on resident birds of target species (or alternatively surveillance on poultry farms in low risk areas only)
2. Surveillance on wild birds specimens found dead
3. Entomological surveillance
4. Clinical surveillance in equids
5. Surveillance of human cases: carried out throughout the year throughout the national territory

Detection of viral circulation in vectors, animals and humans: trigger to start NAT testing of blood and organ donations

PNA: Surveillance and response to arboviruses transmitted by invasive mosquito species (*Aedes* sp.), particularly to Chikungunya, Dengue and Zika viruses

Main goal: to reduce the risk of autochthonous transmission of Chikungunya, Dengue and Zika viruses

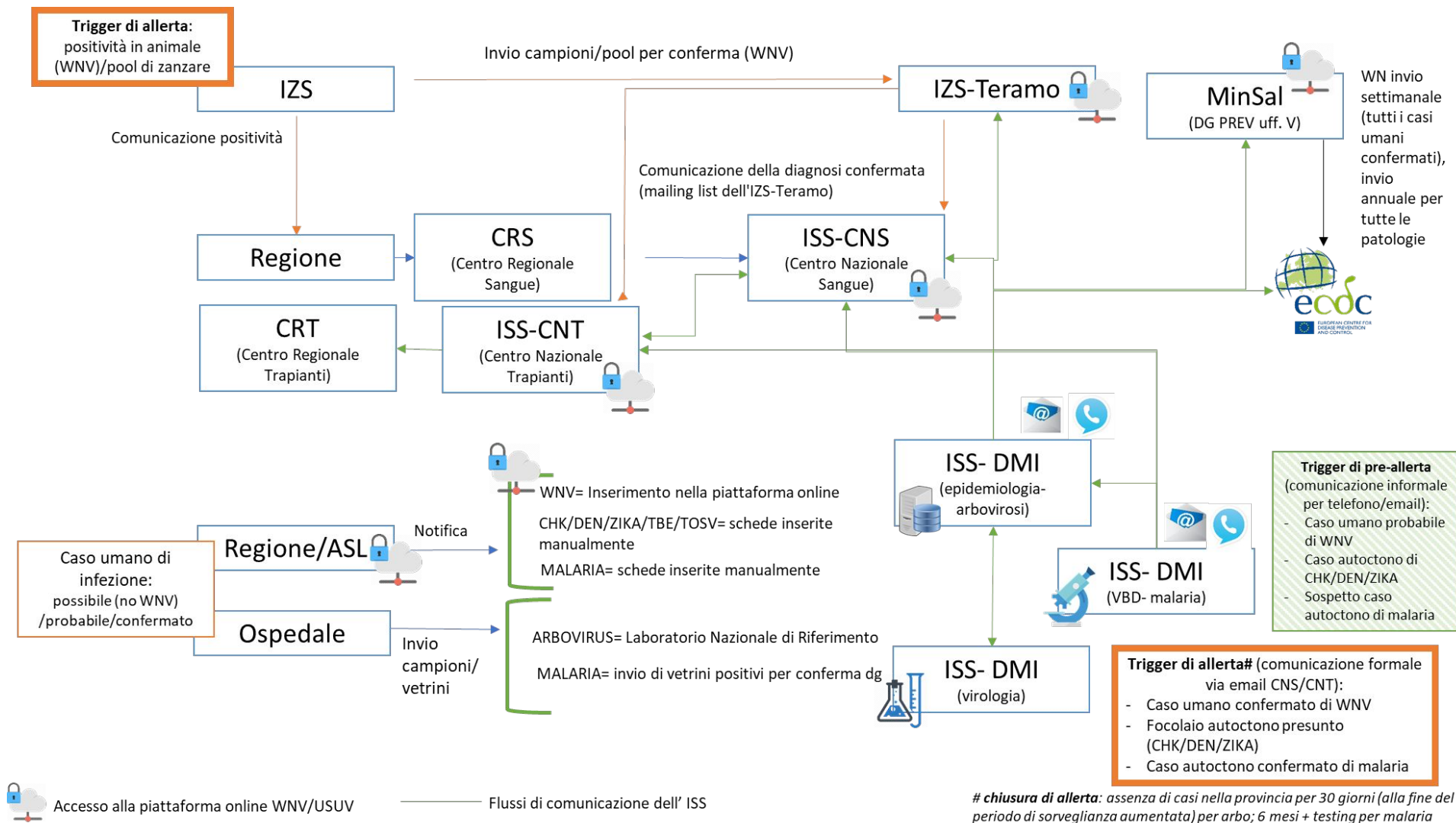
It extends throughout the year; strengthened during the period of increased vector activity, when particular attention should be paid to:

- timely identification of imported cases (subjects meeting clinical and epidemiological case definition criteria)
- the identification of persons with compatible clinical presentation who have not travelled in endemic countries, in order to be able to recognize suspected cases and autochthonous outbreaks

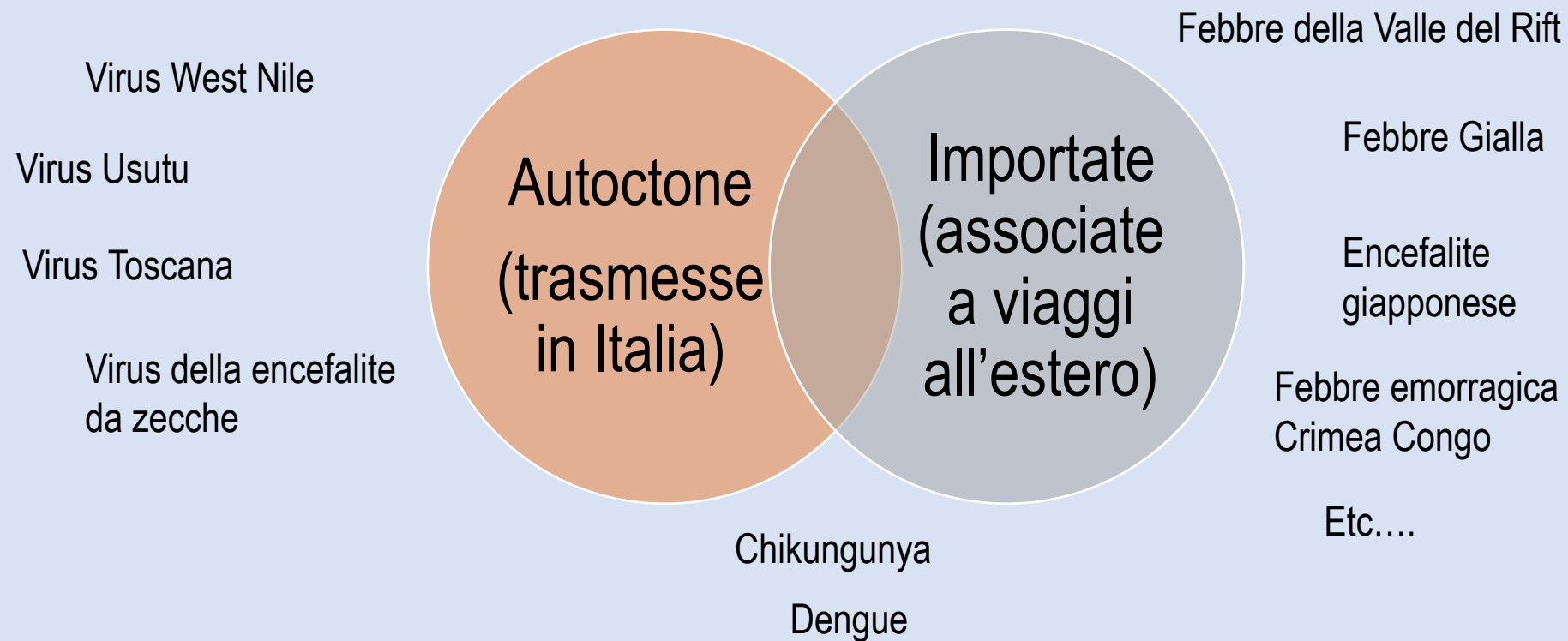
Confirmation of cases:

the physician who suspects a possible case must provide laboratory diagnostic tests, and/or send samples to a Reference Laboratory for confirmation of the case according to case definition criteria.

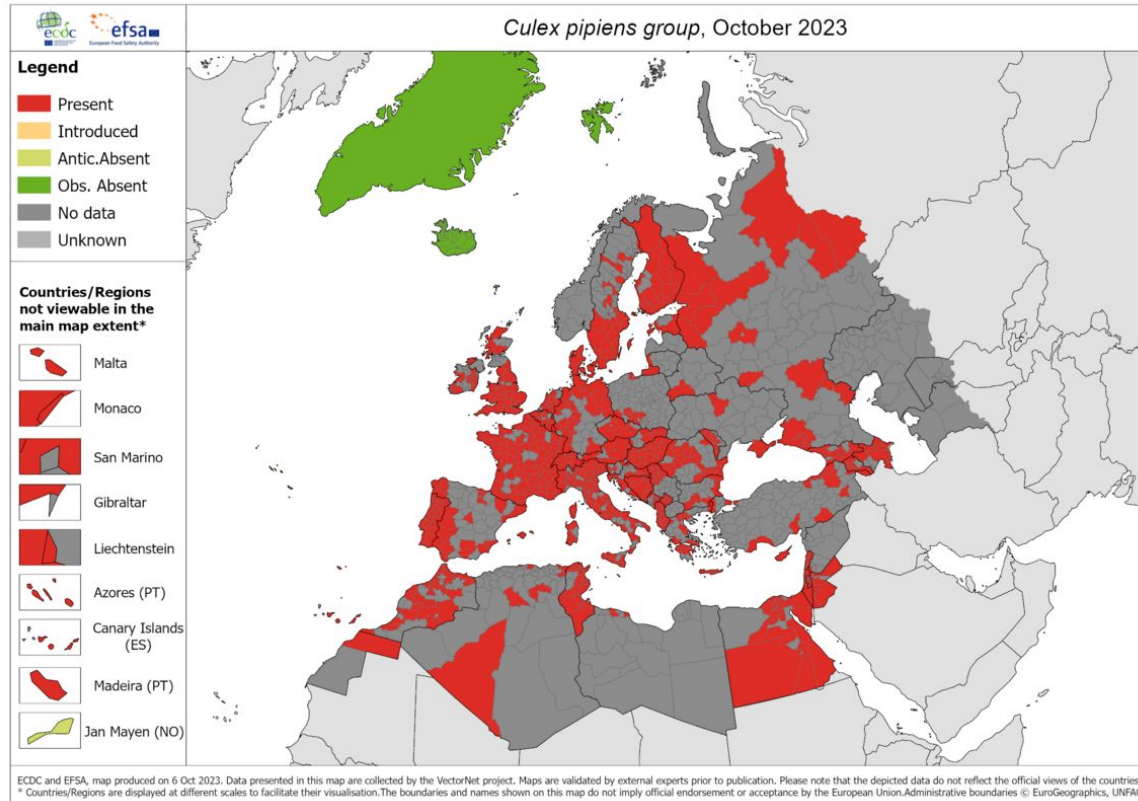
La Sorveglianza integrata delle Arbovirosi



Arbovirosi in Italia



West Nile virus in Italia (1)

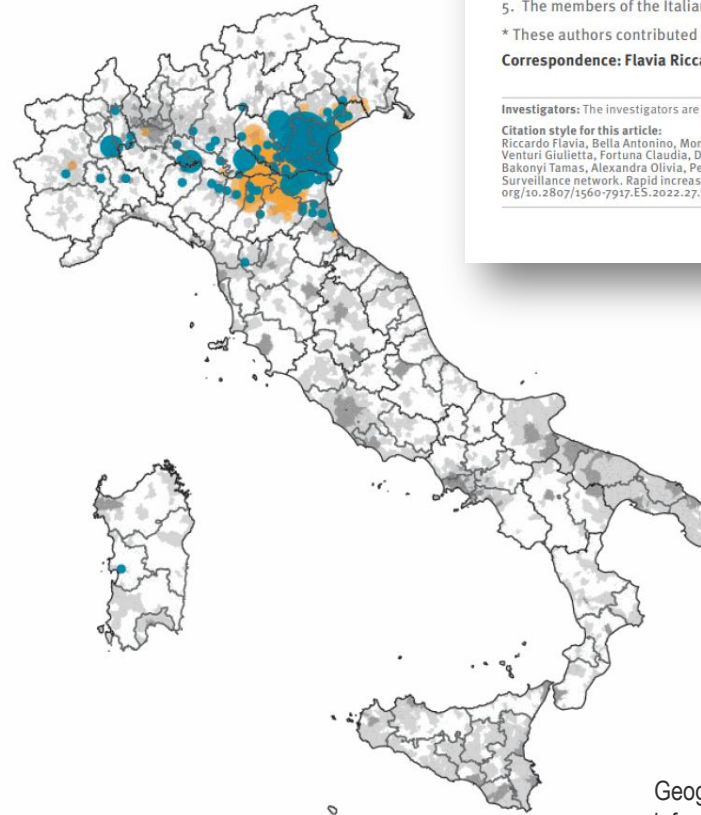


- **Vettore ubiquitario:** principalmente *C. pipiens* (serbatoio - avifauna)
- **Trasmissione enzootica endemica** che coinvolge uccelli migratori a medio e corto raggio e avifauna stanziale
- **Circolazione virale stagionale costante** in alcune Regioni con variazioni annuali
- **Casi sporadici di infezione** in aree epidemiologicamente distinte dalle aree a rischio

Fonte immagine: European Centre for Disease Prevention and Control <https://www.ecdc.europa.eu/en/disease-vectors/surveillance-and-disease-data/mosquito-maps>

West Nile virus in Italia (2)

- Infezione acuta autoctona identificata per la prima volta **nei cavalli nel 1998** e **nell'uomo nel 2008**
- Trasmissione locale documentata **ogni anno** (in media, fino al 2018, 60 casi umani autoctoni di infezione) principalmente nelle regioni settentrionali del paese
- La maggior parte dei casi autoctoni nell'uomo esposti in are **scarsamente/ mediamente popolate (aree rurali o con bassa urbanizzazione)**
- Epidemie documentate nel 2018 e nel 2022 (oltre 10 volte i casi attesi)
- Progressiva **espansione** delle province con almeno un caso autoctono di infezione segnalata ogni anno (da 9 nel 2012 a 41 nel 2022)



RAPID COMMUNICATION

Rapid increase in neuroinvasive West Nile virus infections in humans, Italy, July 2022

Flavia Riccardo^{1,2}, Antonino Bella^{1,2}, Federica Monaco², Federica Ferraro³, Daniele Petrone¹, Alberto Mateo-Urdiales¹, Xanthi D Andrianou⁴, Martina Del Manso¹, Giulietta Venturi¹, Claudia Fortuna¹, Marco Di Luca¹, Francesco Severini¹, Maria Grazia Caporali¹, Daniela Morelli², Federica Iapaolo², Ilaria Pati¹, Letizia Lombardini¹, Tamas Bakonyi⁴, Olivia Alexandra⁴, Patrizio Pezzotti¹, Maria Gabriella Perrotta³, Francesco Maraglino³, Giovanni Rezza³, Anna Teresa Palamara¹, Italian Arbovirus Surveillance network⁵

1. Istituto Superiore di Sanità, Rome, Italy
2. Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise, Teramo, Italy
3. Italian Ministry of Health, Rome, Italy
4. European Centre for Disease Prevention and Control (ECDC), Stockholm, Sweden
5. The members of the Italian Arbovirus Surveillance network are listed under Collaborators

* These authors contributed equally to this work and share first authorship.

Correspondence: Flavia Riccardo (flavia.riccardo@iss.it)

Investigators: The investigators are listed at the end of the article

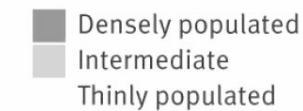
Citation style for this article:
Riccardo Flavia, Bella Antonino, Monaco Federica, Ferraro Federica, Petrone Daniele, Mateo-Urdiales Alberto, Andrianou Xanthi D, Del Manso Martina, Venturi Giulietta, Fortuna Claudia, Di Luca Marco, Severini Francesco, Caporali Maria Grazia, Morelli Daniela, Iapaolo Federica, Pati Ilaria, Lombardini Letizia, Bakonyi Tamas, Alexandra Olivia, Pezzotti Patrizio, Perrotta Maria Gabriella, Maraglino Francesco, Rezza Giovanni, Palamara Anna Teresa, Italian Arbovirus Surveillance network. Rapid increase in neuroinvasive West Nile virus infections in humans, Italy, July 2022. Euro Surveill. 2022;27(36):pii=2200653. <https://doi.org/10.2807/1560-7917.ES.2022.27.36.2200653>

Article submitted on 17 Aug 2022 / accepted on 08 Sept 2022 / published on 08 Sept 2022

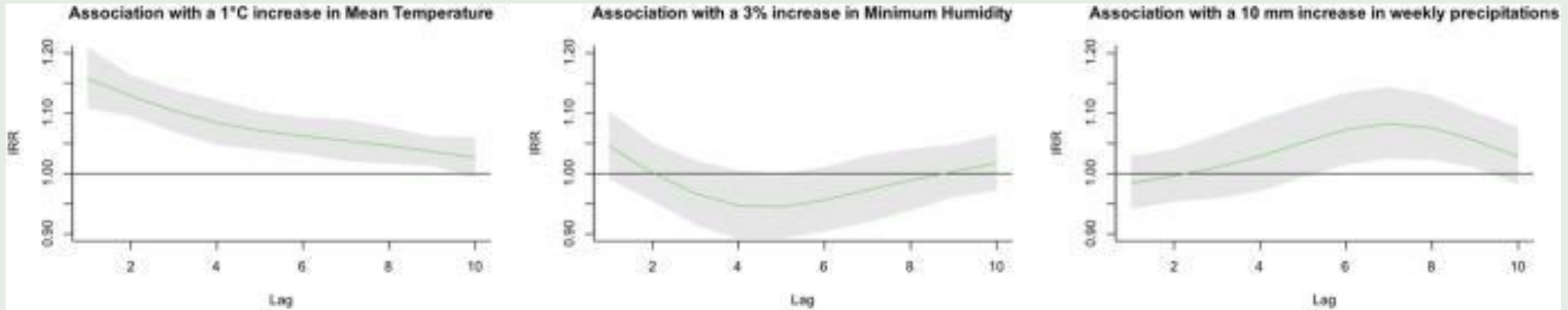
Cases



Degree of urbanisation



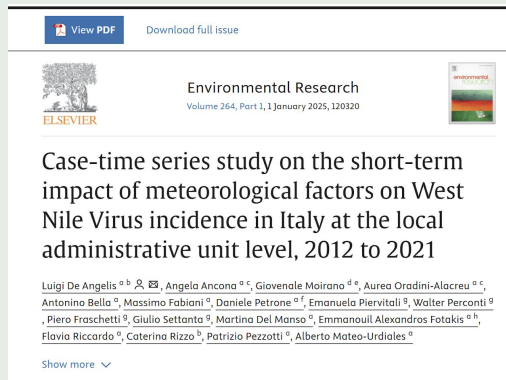
Geographical distribution of West Nile virus human infections in regions with at least one human case with onset or diagnosis up to 31 July, by affected municipality and degree of urbanisation, Italy, 2018 vs 2022 (as of 24 August 2022)



Weeks with higher mean temperature in Northern Italy significantly heighten West Nile Virus (WNV) transmission.

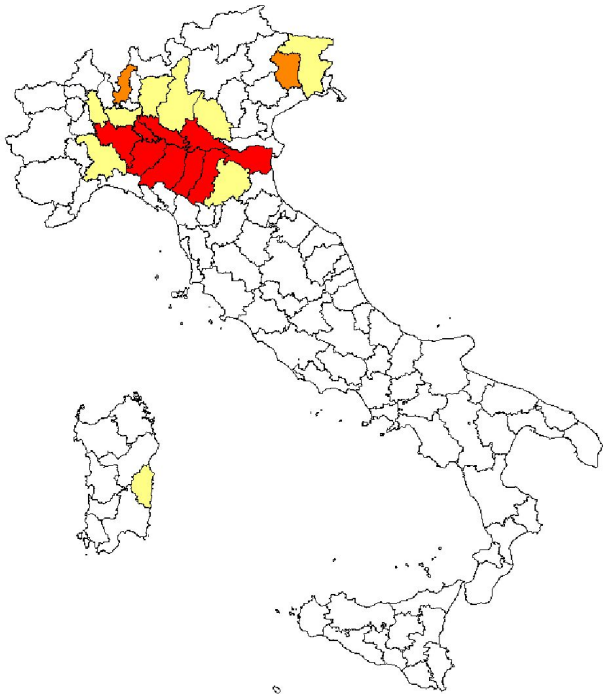
Abundant rainfalls in the previous 6–9 weeks increase the incidence rate of WNV cases in Northern Italy.

High spatial resolution climatic data at the Local Administrative Unit Level can enhance WNV surveillance.



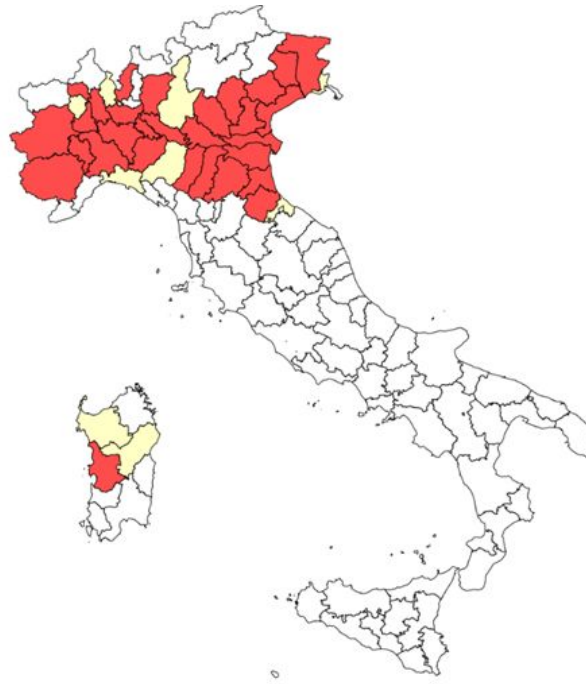
Year: 2015, Week: 3-9 September

Provinces affected: 20



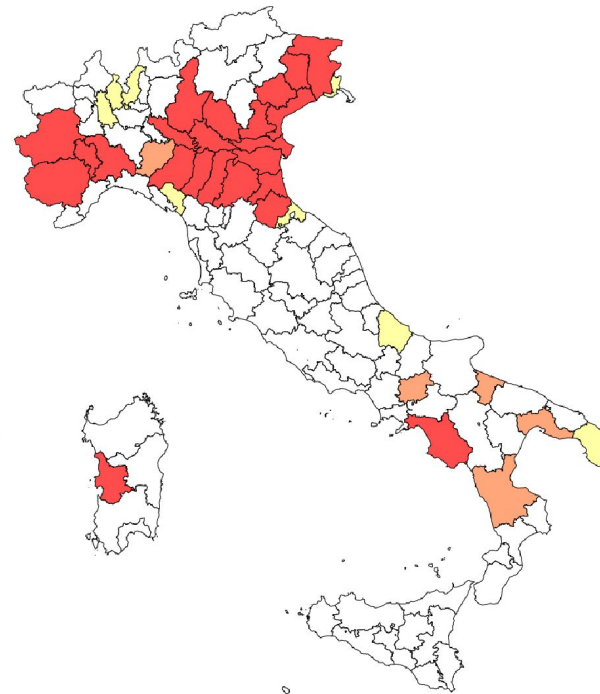
Year: 2018, Week: 23-28 August

Provinces affected: 38



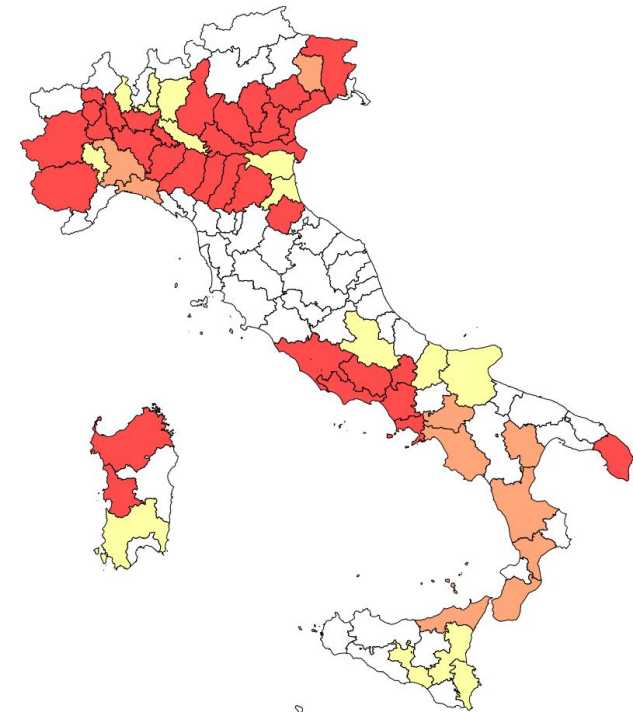
Year: 2024, Week: 23-28 August

Provinces affected: 36



Year: 2025, Week: 21-27 August

Provinces: 57

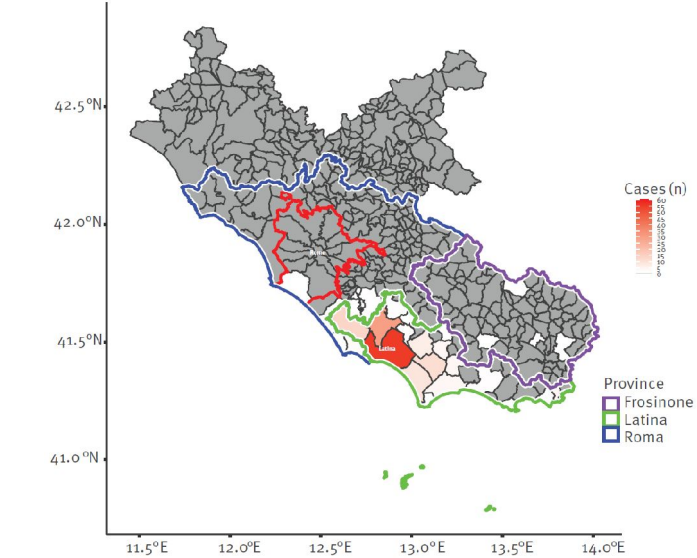


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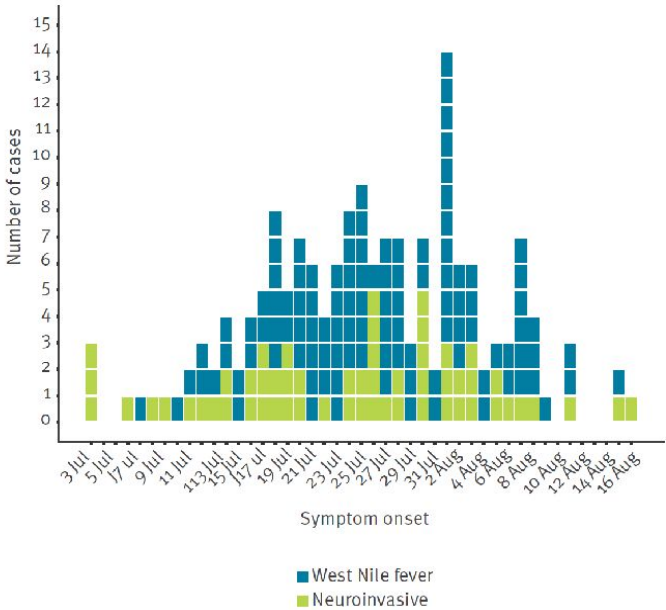


DIPARTIMENTO
MALATTIE INFETTIVE

Outbreak of autochthonous West Nile virus infection in Lazio region, Italy, July to August 2025: preliminary investigation



A. Confirmed cases in humans



B. Sampling of animals

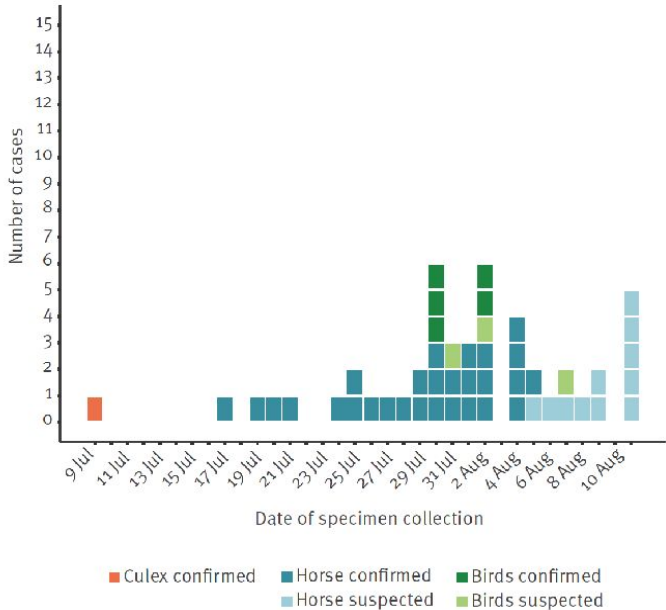
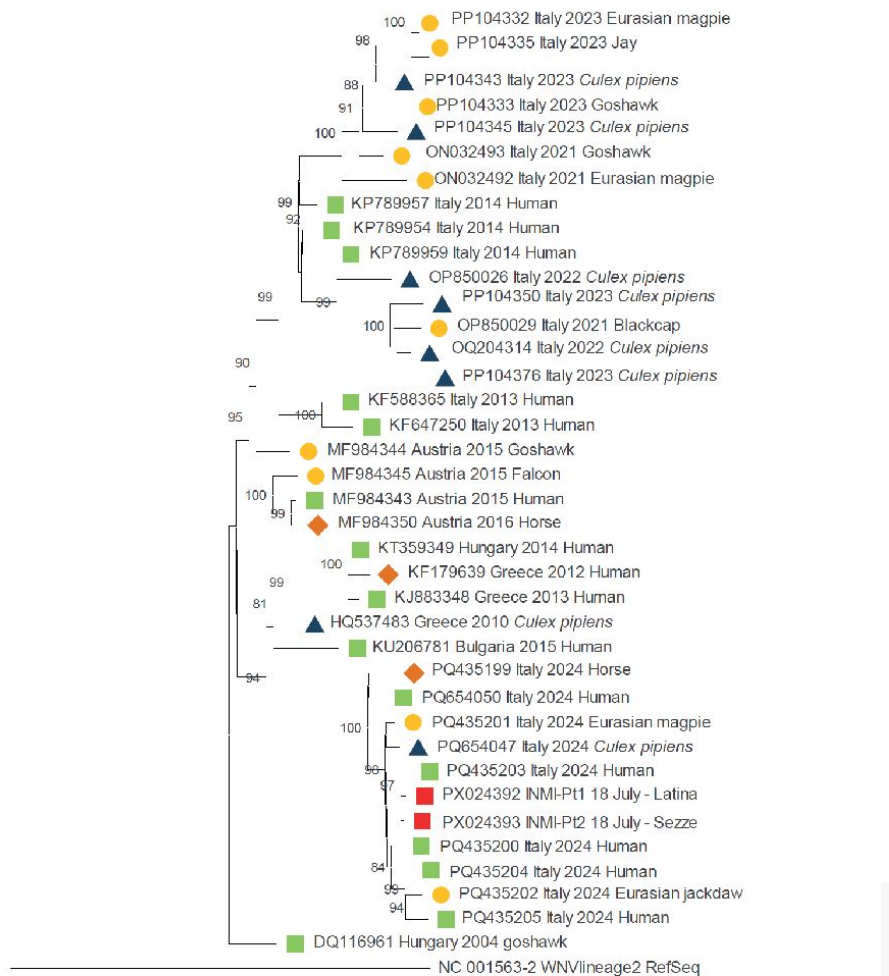
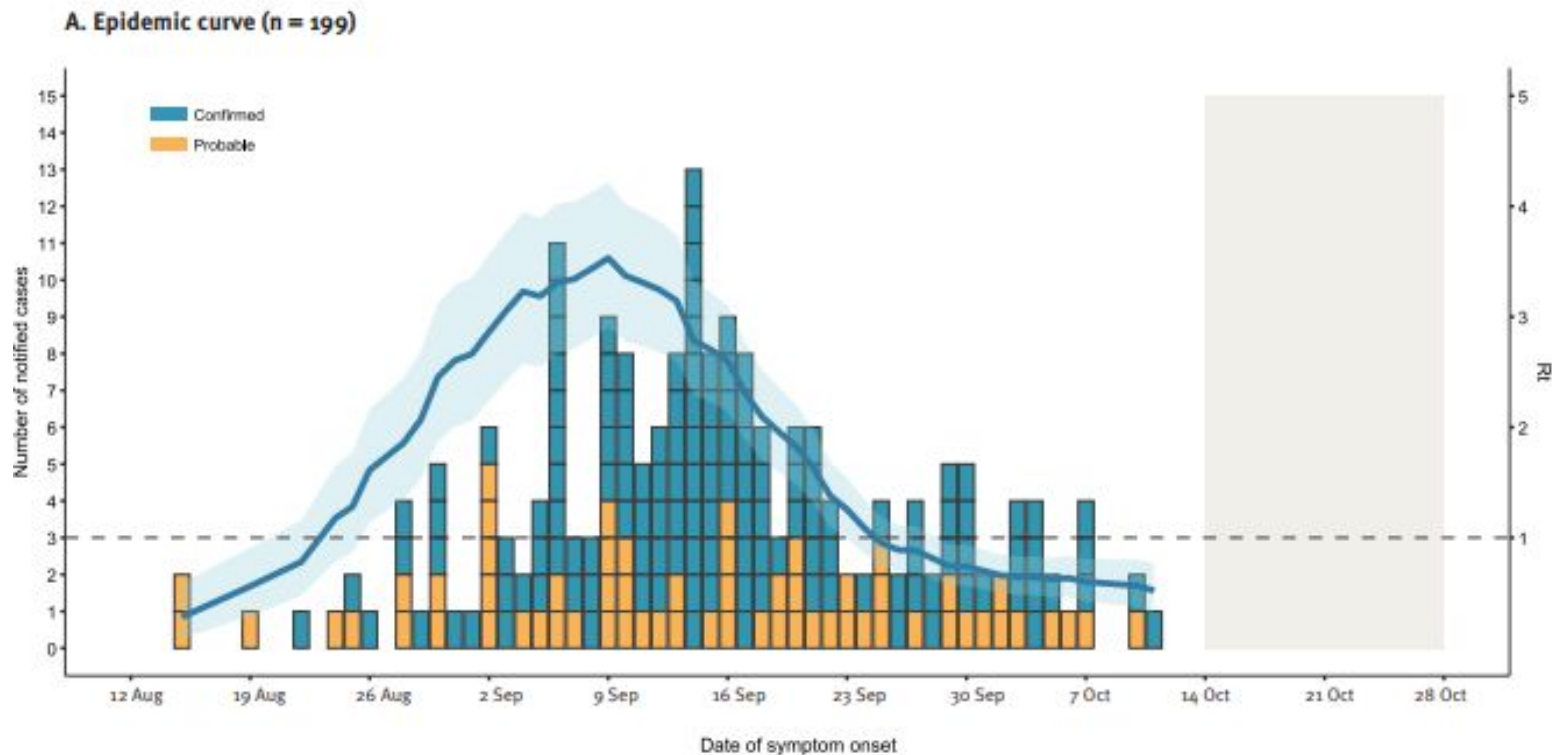


FIGURE 3
Phylogenetic analysis of full-length genome sequences from two autochthonous cases of West Nile virus infection in 1 July 2025 and sequences from humans (n = 15), birds (n = 11) and horses (n = 2)



Dengue outbreak Fano 2024

From august we have had notifications of local transmission events in Fano (Marche)



Rapid communication

Open Access

Autochthonous dengue outbreak in Marche Region, Central Italy, August to October 2024

Like 0

Download

Chiara Sacco^{1,2*}, Augusto Liverani^{3,*}, Giulietta Venturi¹, Stefano Gavaudan⁴, Flavia Riccardo¹, Giovanna Salvoni⁵, Claudia Fortuna¹, Katia Marinelli⁶, Giulia Marsili¹, Alessia Pesaresi³, Carla Molina Grané⁷, Irene Mercuri³, Manica⁷, Sara Caucci⁶, Daniela Morelli⁸, Lolita Sebastianelli⁹, Maurilia Marcacci⁸, Federica Ferraro¹⁰, Marco Di Luca¹, Iscucci⁴, Christina Merakou¹, Anna Duranti⁴, Ilaria Pati¹¹, Letizia Lombardini¹², Daniel Fiacchini¹³, Giorgio Filippini⁹, co Maraglino¹⁰, Anna Teresa Palamara¹, Piero Poletti⁷, Patrizio Pezzotti¹, Fabio Filippetti⁹, Stefano Merler^{7,14}, Del Manso^{1,14}, Stefano Menzo^{6,14}, Marche dengue outbreak group¹⁴

Epidemic curve of probable and confirmed autochthonous dengue cases and public health measures taken to contain a dengue outbreak, Fano, Italy, August–October 2024 (n = 199)

Chikungunya outbreak Carpi 2025 – oltre 100 casi autoctoni, in corso

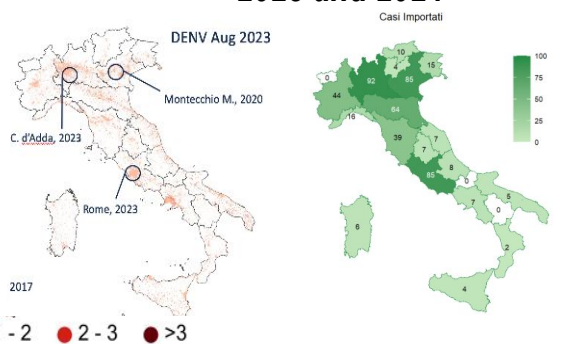


Chikungunya outbreak provincia Verona 2025 – oltre 30 casi, diversi comuni Valpolicella, in corso

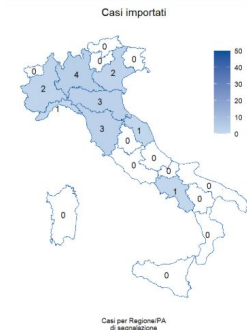
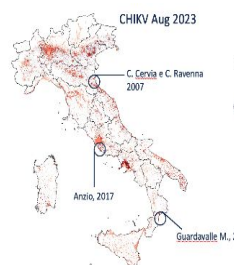
Arbovirosi

• DENV

2023 and 2024



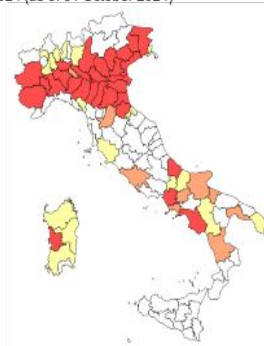
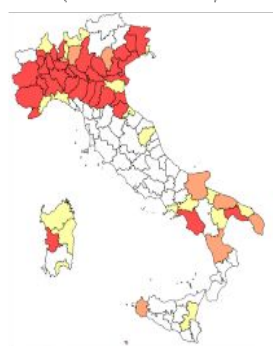
• CHIKV



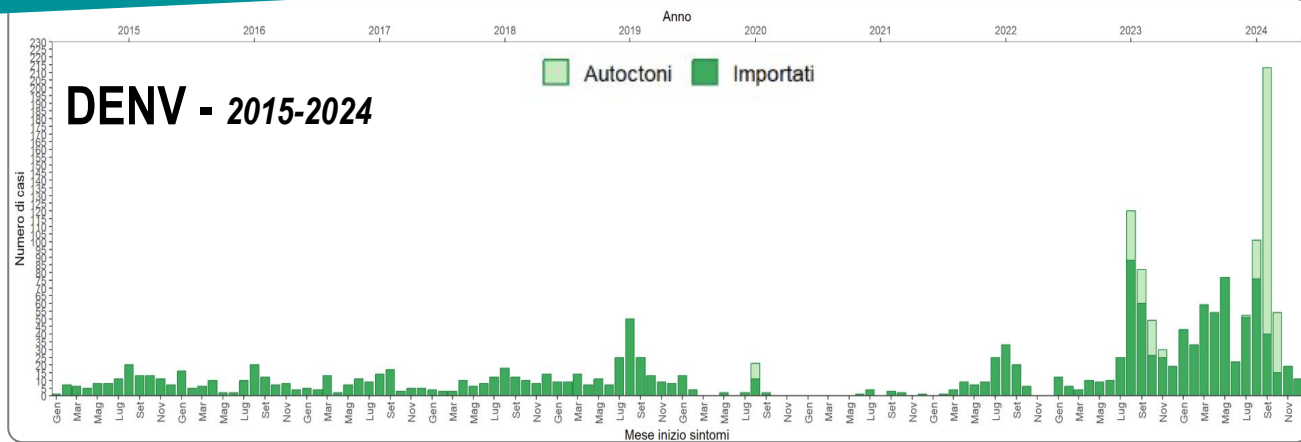
• West Nile Virus

2023 (as of 9 November 2023)

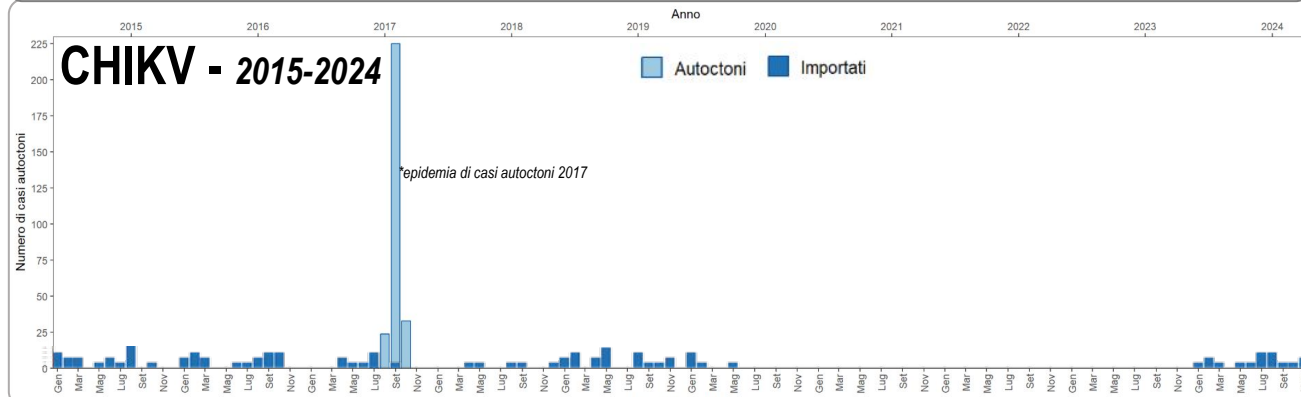
2024 (as of 31 October 2024)



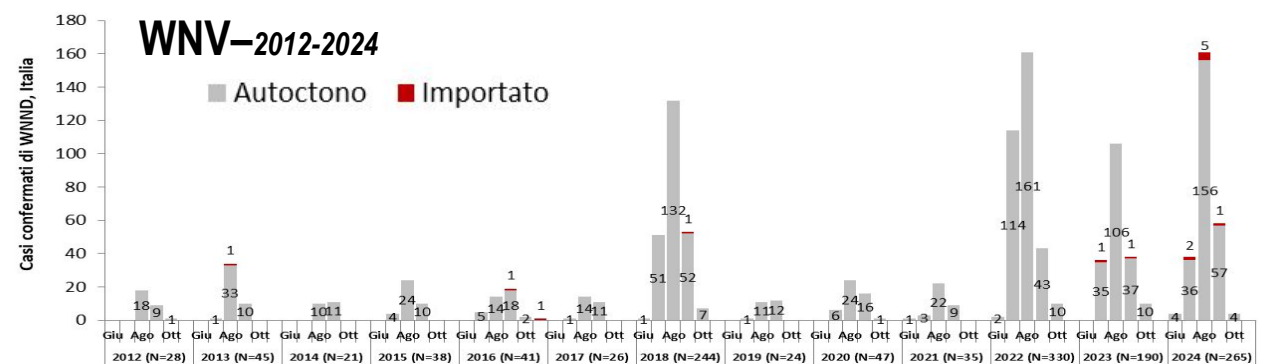
DENV - 2015-2024



CHIKV - 2015-2024



WNV-2012-2024



Del Manso M, Di Maggio E, Petrone D, Mateo-Urdiales A, Bella A, Venturi G, Di Luca M, Giannitelli S, Maraglino F, Ferraro F, Pezzotti P, Riccardi F; Arbovirosi in Italia - 2
Data di ultimo aggiornamento: 28 maggio 2025

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- assess the effectiveness of these vectors in transmitting and spreading exotic diseases across Europe; and
- bolster laboratory capabilities for monitoring insecticide resistance in vectors.

Sorveglianza entomologica con approcci tradizionali

A cosa serve

- Determinazione della presenza/assenza di vettori
- Allerta per l'ingresso di nuove specie invasive
- Dati sulle fluttuazioni nella dinamica di specie
- Identificazione di potenziali patogeni trasmessi
- Indicazioni su quando e dove fare interventi di controllo
- Valutazione dell'efficacia degli interventi di controllo

Limiti

- Informazione a bassa risoluzione temporale e spaziale
- Necessarie qualificate competenze in ambito entomologico
- Costo elevato in termini di tempo e lavoro
- Ritardo tra campionamento e utilizzo del dato





Cos'è?

MosAIco è un consorzio di **18** istituti di ricerca (PNRR), coordinato da ISS che sta sviluppando un piccolo dispositivo portatile che cattura immagini multi-oggetto ad alta risoluzione. Ogni immagine è analizzata da un algoritmo di deep-learning che fornisce una classificazione a livello di specie, in tempo reale e con un certo grado di affidabilità.

A cosa serve?

Per velocizzare, ottimizzare e armonizzare le attività di sorveglianza entomologica volte a mappare le dinamiche spazio-temporali delle popolazioni di specie di zanzare, anche da parte di **operatori non esperti**.

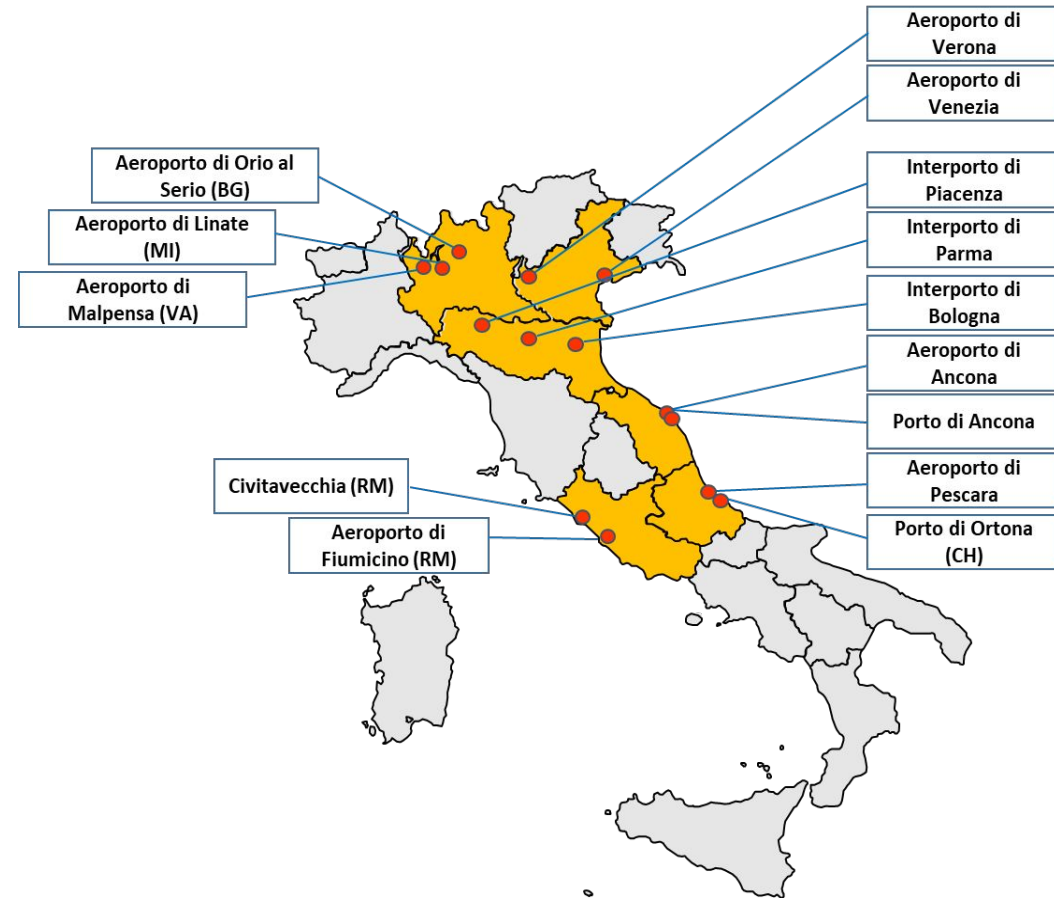
Obiettivi

- Sviluppare uno strumento di **identificazione rapida**, tecnologicamente avanzato, per affrontare le emergenze in un'ottica *One health*
- Avere **dati** sulle dinamiche spazio-temporali di *Aedes*, *Culex* e *Anopheles* utilizzabili per la costruzione di mappe di rischio

Prossimi step

- Migliorare le performance del modello di IA (% di confidenza) e il numero di specie di zanzare italiane da identificare (finora validato su **7** specie di vettori)

Sorveglianza dell'ingresso e diffusione di zanzare invasive del genere Aedes e degli arbovirus da esse trasmessi con particolare riferimento alla Dengue



ENTE CAPOFILA

UO1: ISS; Marco Di Luca

ENTI PARTECIPANTI

UO2: IZSve; Fabrizio Montarsi

UO3: IZSLER; Francesco Defilippo/Mattia Calzolari

UO4: IZSUM; Stefano Gavaudan

UO5: IZSAM; Maria Goffredo

UO6: IZSLT; Claudio De Liberato

UO7: UNISAP; Beniamino Caputo

UO8: UNISAP; Marco Pombi

UO9: FBK; Stefano Merler

DURATA PROGETTO: 24 mesi (inizio 27/06/2025 – fine 26/06/2027)

BUDGET: 200.000 €

Cosa ereditiamo dal PNRR?



National Reference Relational
Database (NRRD) of
arthropod vectors



National Network
of Insectary
Facilities (NNIF)



Repository of
Arthropod Vectors
of Italy (RAV-IT)

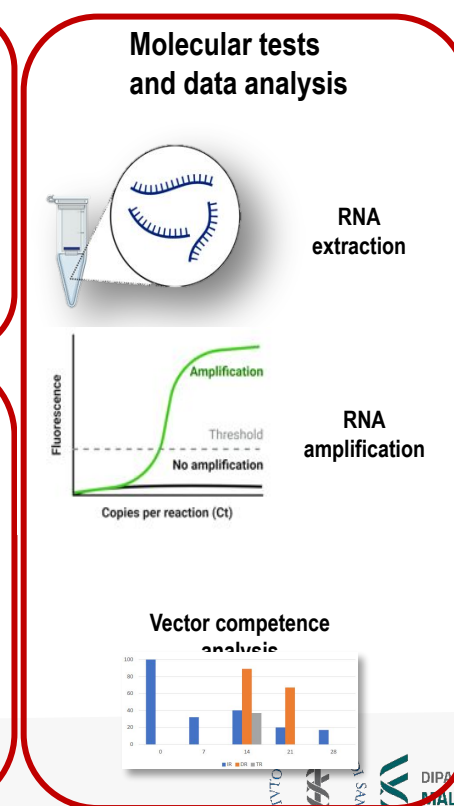
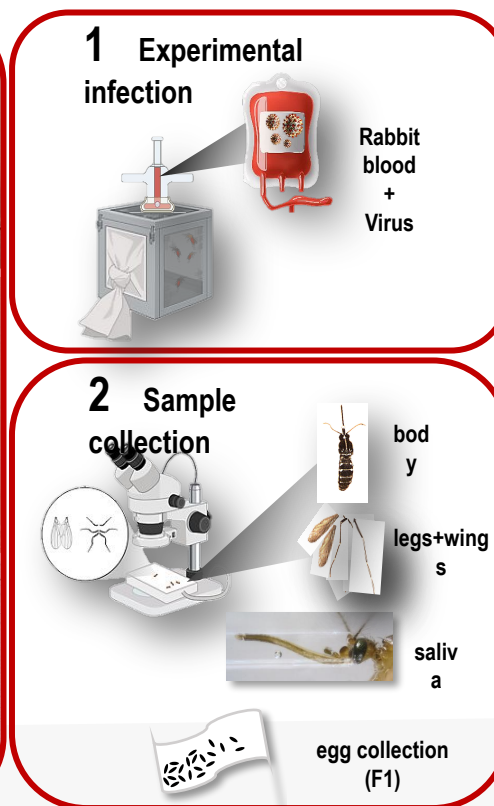
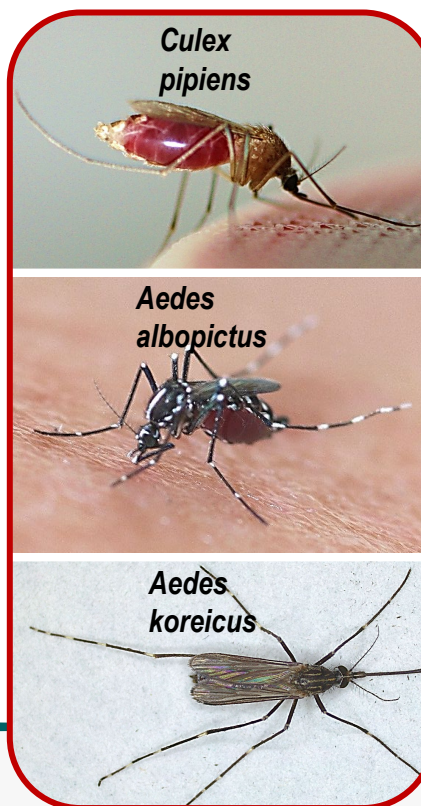


Italian Insecticide
Resistance Network

Infezioni sperimentali per gli studi di competenza vettoriale



Specie di zanzara	Virus	Occasione / Motivazione dello studio
<i>Aedes albopictus</i>	Chikungunya virus	Epidemie italiane (2007 – 2017)
<i>Aedes albopictus</i> e <i>Culex pipiens</i>	Zika virus	2014: dichiarazione di emergenza sanitaria pubblica di rilevanza internazionale (PHEIC)
<i>Aedes albopictus</i> e <i>Culex pipiens</i>	SARS-CoV-2	Pandemia da Covid-19
<i>Aedes albopictus</i> e <i>Culex pipiens</i>	Oropouche virus	Epidemia a Cuba (2024)
<i>Aedes koreicus</i>	Dengue virus West Nile virus	Valutazione della competenza vettoriale di nuove specie invasive



Attuali criticità

- Malgrado miglioramenti nel 2025 su rapida identificazione circolazione vettore e patogeno, difficoltà nelle misure di controllo e contenimento degli outbreaks
- Sorveglianza vettore (culex, aedes) non omogenea sul territorio
- Mancanza di sorveglianza della diffusione della resistenza agli insetticidi
- Competenze limitate sul territorio in ambito entomologico
- Necessità di colmare gaps conoscenza su ruolo fattori ecologici e ambientali
- Necessità di migliorare la ricerca dei patogeni nei vettori e negli animali serbatoio
- Implementazione diffusa di sorveglianza genomica