1st Symposium on "Research and Innovation for the control of vectors of emerging arboviruses"

Agropolis International - Montpellier

14 February 2023

The Worldwide Insecticide resistance Network (**WIN**)

&

The Research and InNOvation Partnership for enhancing the surveillance and control of mosquito VECtors of emerging arboviruses (**INOVEC**)

Vincent CORBEL

Research Professor at IRD,

Associate researcher at FIOCRUZ-IOC

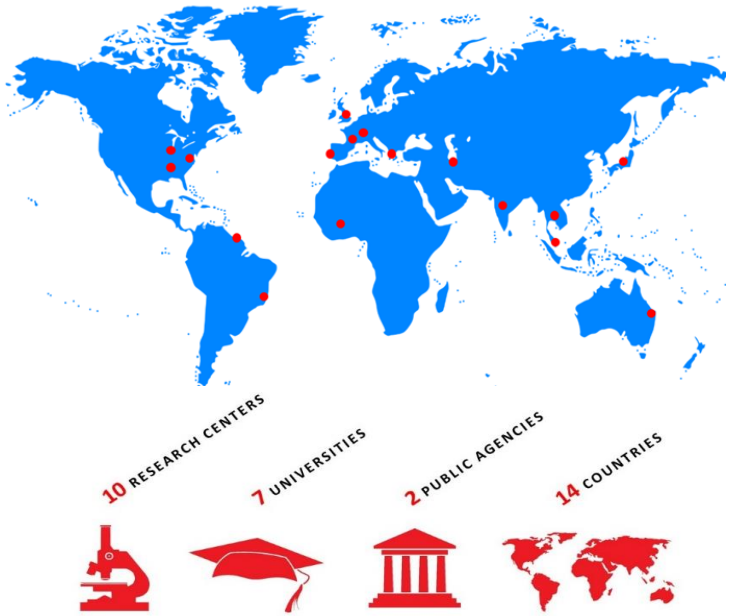
PLOS | NEGLECTED TROPICAL DISEASES

VIEWPOINTS

Tracking Insecticide Resistance in Mosquito Vectors of Arboviruses: The Worldwide Insecticide resistance Network (WIN)

Network objectives

- Establishing a global resistance surveillance network in arbovirus vectors
- Filling knowledge gaps & identify research priorities on insecticide resistance
- Assisting WHO and national authorities in decision-making for IR management



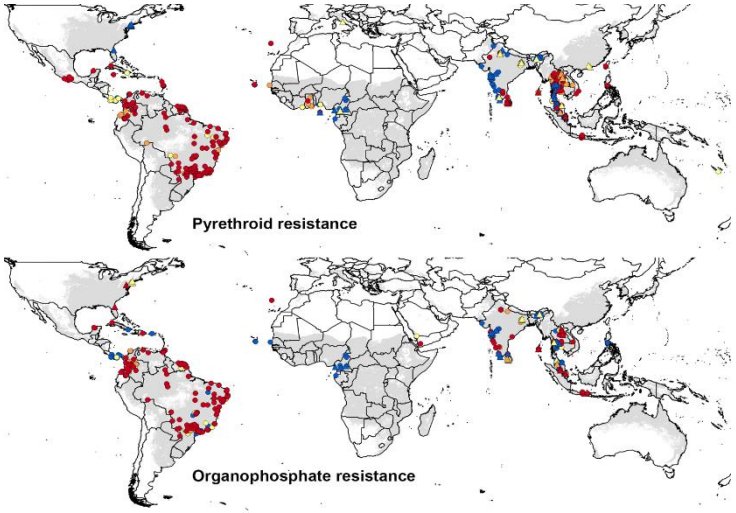
http://win-network.ird.fr

Mapping Aedes resistance

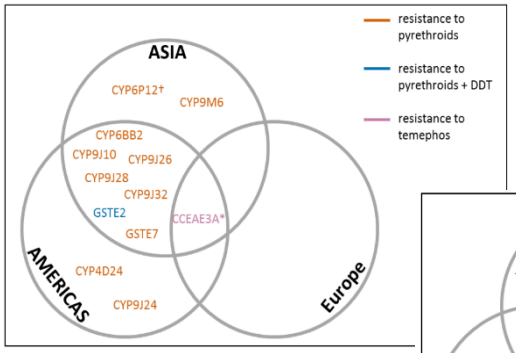
PLOS NEGLECTED TROPICAL DISEASES

Contemporary status of insecticide resistance in the major *Aedes* vectors of arboviruses infecting humans

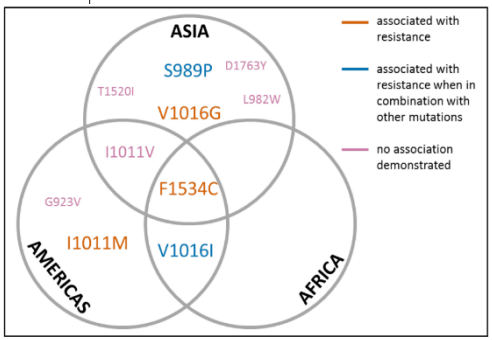
Global distribution of PYR & OP resistance



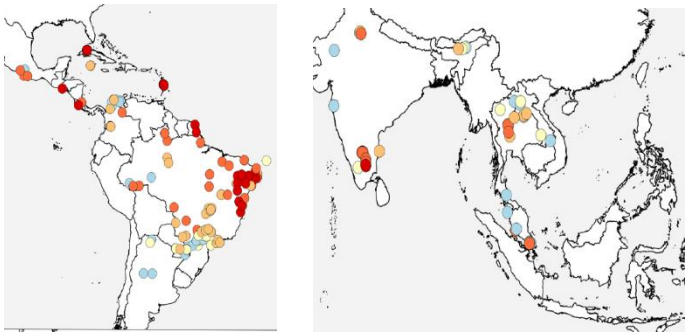
Dispersion of metabolic resistance markers



and kdr mutations…



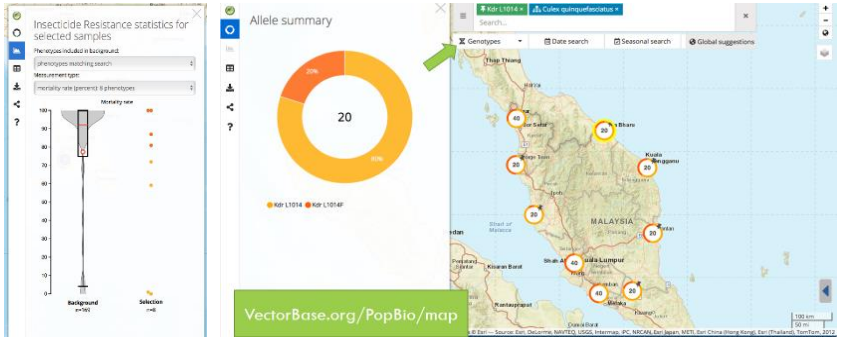
Temephos resistance per WHO region



Moyes et al. *Plos NTD* 2017

Centralized IR database

VectorBase
Bioinformatics Resource for Invertebrate Vectors of Human Pathogens

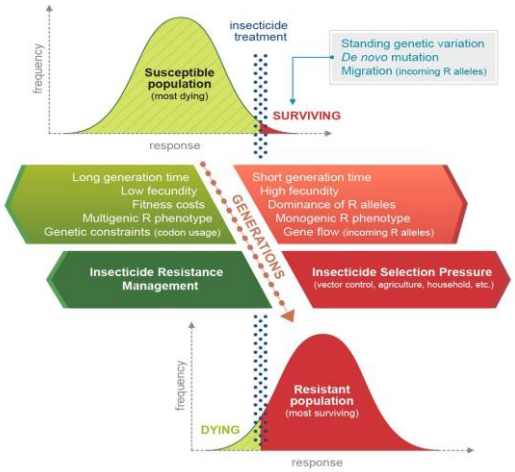


Insecticide resistance management (IRM)

PLOS | NEGLECTED TROPICAL DISEASES

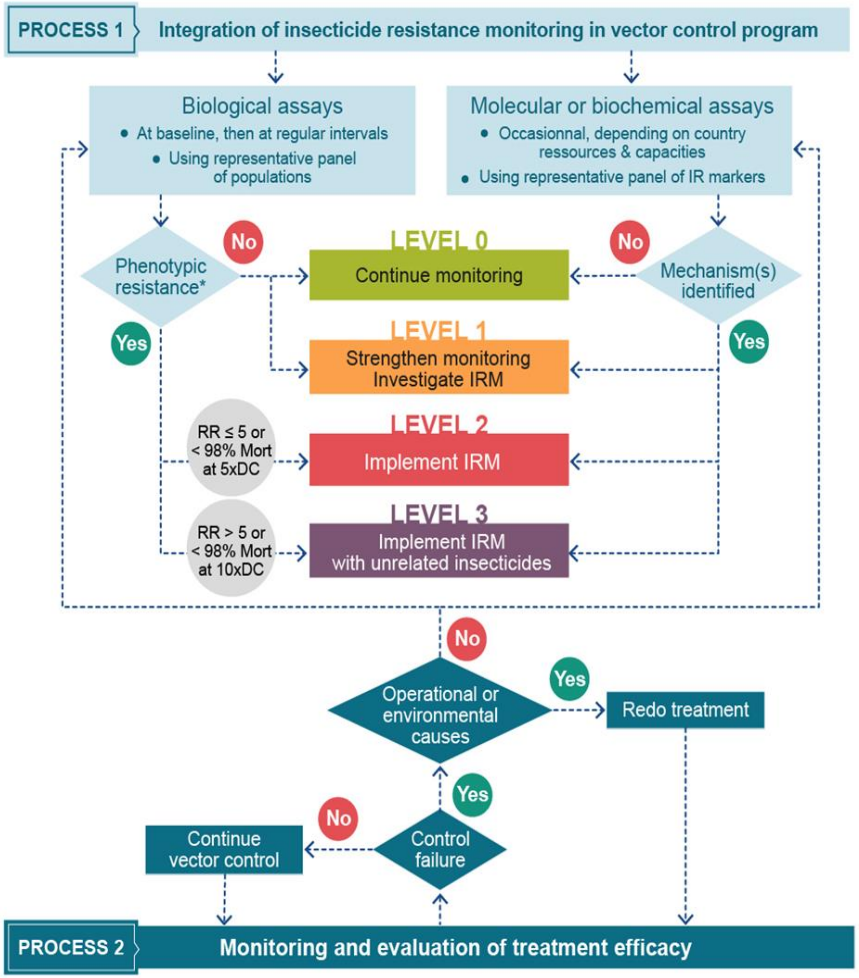
REVIEW

Management of insecticide resistance in the major Aedes vectors of arboviruses: Advances and challenges



Concepts underlying the evolution of Insecticide resistance

Framework for implementation of IRM



Advantages and drawbacks of detection methods

Methods	Advantages	Disadvantages
Biological assays		
Diagnostic concentrations 	• Standardized • Simple and rapid to perform • Detect resistance phenotype	• Lack of sensitivity • No information on level or type of resistance • Few diagnostic doses available for *Aedes* spp. • Require live mosquitoes • Require universal quality insecticides
Dose-response assays	• Measure resistance levels	• Require large number of live mosquitoes • Require a susceptible reference colony
Assays using synergists	• Information on the potential mechanisms responsible for resistance	• Lack of sensitivity and specificity • Require large number of live mosquitoes
Biochemical assays measuring enzyme activities 	• Information on mechanisms responsible for resistance • Several mechanisms tested on a single individual	• Require a cold chain • Not available for all resistance mechanisms • Lack of sensitivity/specificity
Molecular assays to detect resistant alleles 	• Very sensitive • Several mechanisms tested on single individuals • Detect recessive alleles and provide an "early warning" of future resistance	• Require specialized and costly equipment • Only available for a limited number of resistance mechanisms • Are not always easily linked to resistance levels

Dusfour et al. *Plos NTD* 2018

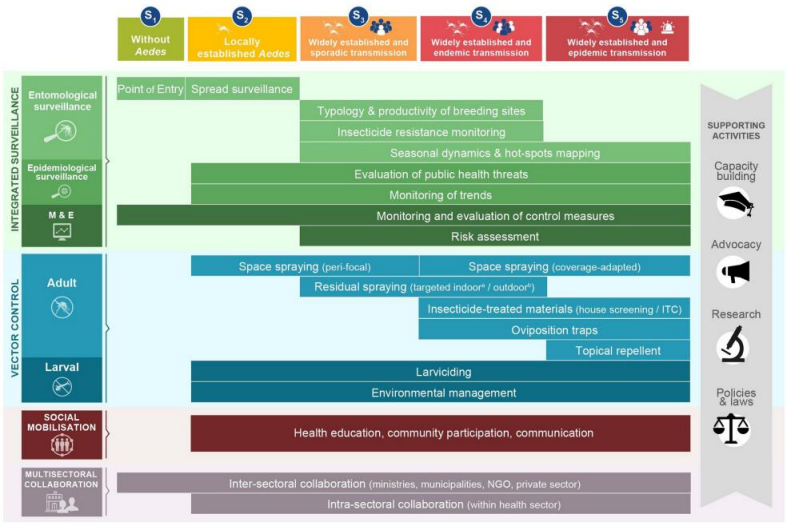
Other publications

PLOS | NEGLECTED TROPICAL DISEASES

REVIEW

Integrated *Aedes* management for the control of *Aedes*-borne diseases

David Roiz[1]*, Anne L. Wilson[2], Thomas W. Scott[3], Dina M. Fonseca[4], Frédéric Jourdain[1], Pie Müller[5,6], Raman Velayudhan[7], Vincent Corbel[1]*

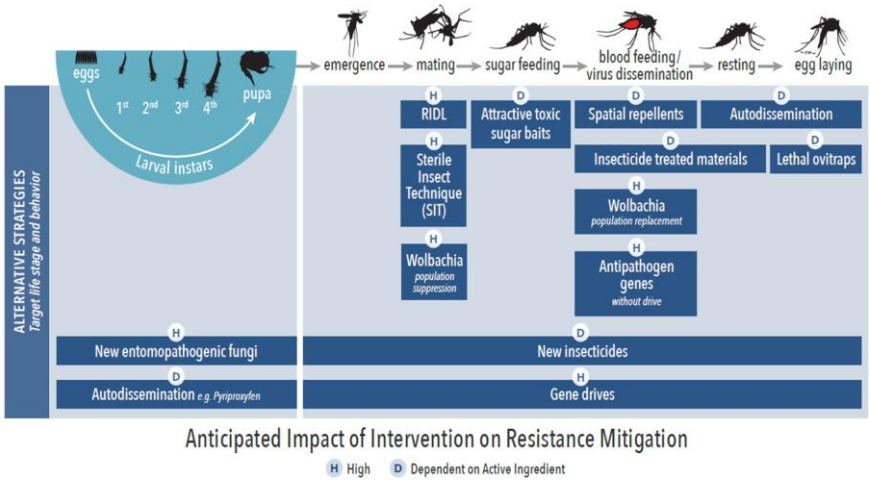


"A comprehensive evidence-based guidance on how and when to implement Aedes control measures tailored to local entomological and epidemiological risk scenarios"

REVIEW

Alternative strategies for mosquito-borne arbovirus control

Nicole L. Achee[1]*, John P. Grieco[1], Hassan Vatandoost[2], Gonçalo Seixas[3], Joao Pinto[3], Lee Ching-NG[4], Ademir J. Martins[5], Waraporn Juntarajumnong[6], Vincent Corbel[7], Clement Gouagna[7], Jean-Philippe David[8], James G. Logan[9,10], James Orsborne[9], Eric Marois[11], Gregor J. Devine[12], John Vontas[13,14]



"An overview of alternative VC strategies for the control of arbovirus mosquitoes and their anticipated impact on resistance mitigation"

WIN Supporting activities

❑ Conferences (Rio 2016 & Singapore 2018)

Corbel et al. Parasites & Vectors (2017) 10:278
DOI 10.1186/s13071-017-2224-3

Parasites & Vectors

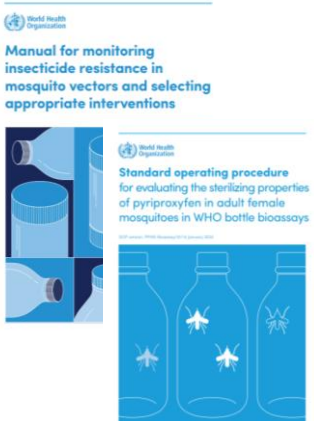
MEETING REPORT

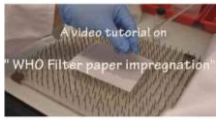
International workshop on insecticide resistance in vectors of arboviruses, December 2016, Rio de Janeiro, Brazil

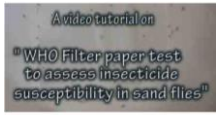
MEETING REPORT Open Access

Second WIN International Conference on "Integrated approaches and innovative tools for combating insecticide resistance in vectors of arboviruses", October 2018, Singapore

❑ WHO reports, guidelines, SOPs, etc

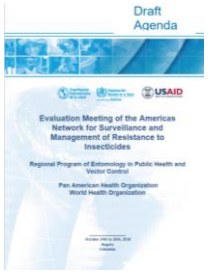


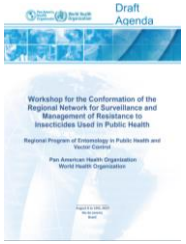




WHAT'S NEXT ?

Expand WIN activities in **South America** to provide MS with **technical and scientific support** to respond to the increasing threat of IR





« to strength the *Regional Network for monitoring of Insecticide Resistance in vectors"*

1st WG meeting, May 2023 at FIOCRUZ-IOC

Pan American Health Organization

CDC Centers for Disease Control and Prevention

FIOCRUZ

GDRI

Horizon Europe Framework Programme (HORIZON)
Call: MSCA Staff Exchanges (2021-SE-01)

A Research & InNOvation Partnership for enhancing the surveillance and control of mosquito VECtors of emerging arboviruses (INOVEC)

Objective: To promote cross-sectoral, multidisciplinary and international collaborations to enhance and promote scientific and technical knowledge on the surveillance and control of mosquito vectors of emerging arboviruses

12 countries
21 institutions
5 privates
1 Int. Organization

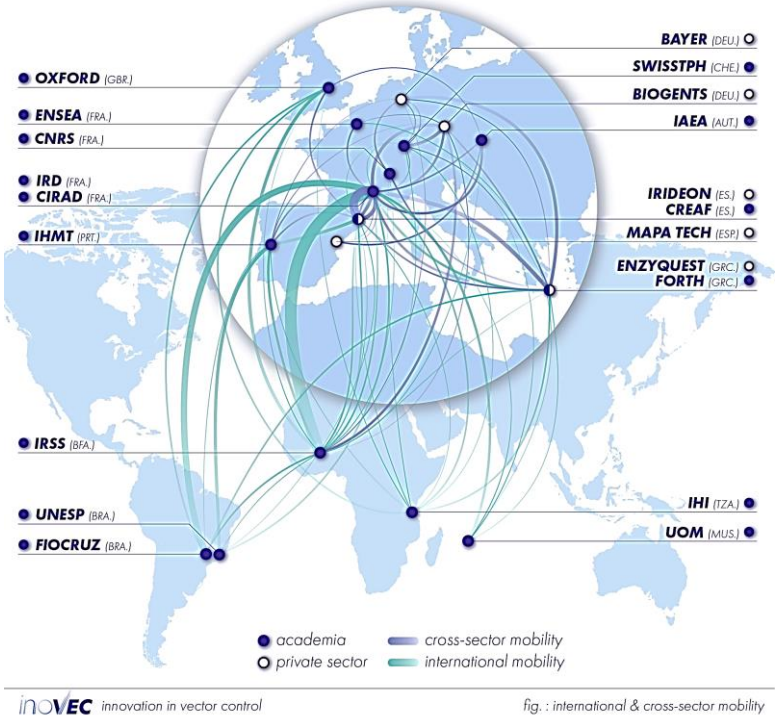
Participants

This project has received funding from the European Union HORIZON-MSCA-2021-SE-01, under the grant No 101086257

Horizon Europe Framework Programme (HORIZON)
Call: MSCA Staff Exchanges (2021-SE-01)

Scientific exchanges to contribute to R&I

A total of 344 PM to support mobility of students, scientists, managerial & technical staff



Main missions

- **Contribute to undergraduate and postgraduate** teaching programmes
- **Supervise students/post doc** during their research activities.
- **Contribute to lab and field works** to generate scientific evidence, concepts/methods and contribute to data collection, analysis, interpretation & dissemination.
- **Contribute to reinforcement of partner capacity,** transfer of knowledge and technology
- **Networking activities** including organization of **workshops** and **conferences**

Work packages activities and outputs

This project has received funding from the European Union HORIZON-MSCA-2021-SE-01, under the grant No 101086257

Key objectives

- **Promote new skills, knowledge acquisition and career development** for the research staff and the entrepreneurs in Europe and Beyond

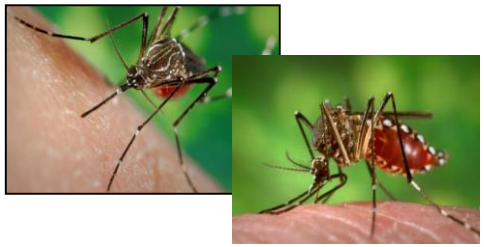
- **Create novel product development pathways** by stimulating connections between companies, biologists and social scientists working on vector control and surveillance

- **Facilitate knowledge sharing by advising decision makers** and disseminating necessary evidence to accelerate access to high-quality vector control products

- **Contribute to the societies' health and** well-being by advocating a judicious, rationale, and integrated use of innovative Vector Control tools

Horizon Europe Framework Programme (HORIZON)
Call: MSCA Staff Exchanges (2021-SE-01)

inoVEC



Thank you for your attention!

inovec.office@ird.fr
Inovec.event@ird.fr

This project has received funding from the European Union HORIZON-MSCA-2021-SE-01, under the grant No 101086257

Objectives

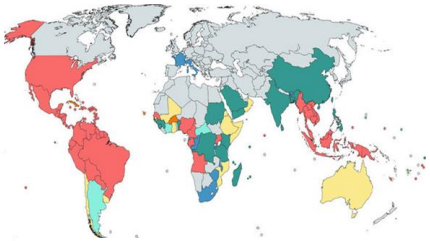
- **Facilitate knowledge sharing by advising decision makers** and disseminating necessary evidence to accelerate access to high-quality vector control products

- **Give access to knowledge by raising public awareness** on *Aedes* and *Aedes*-borne diseases through the engagement of communities and dissemination of results through adequate streams (open sciences) and educational materials.

- **Contribute to the societies' health and well-being by advocating a judicious, rationale and integrated use of vector surveillance and control tools** according to regulatory constraints and environmental considerations and local capacities.

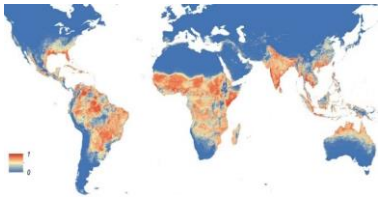
Horizon Europe Framework Programme (HORIZON)
Call: MSCA Staff Exchanges (2021-SE-01)

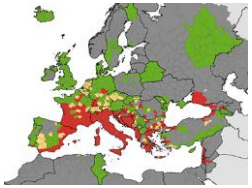
Context & background



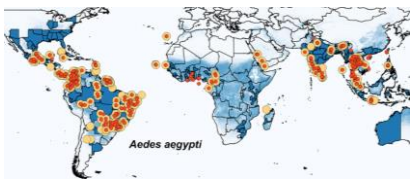
60% of the world populations at risk of 1 or more ABDs (Rucker et al2017)

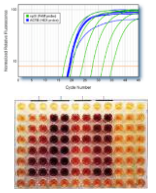
Global changes expose humans to new and re-emerging threats





Aedes distribution is the widest ever recorded in history (kreamer 2015& 2019)

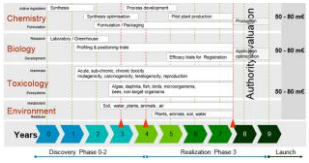




Aedes resistance to PHPs reported in > 57 countries (Moyes et al2017), including the EU

Lack of commitment and political will to sustain vector control (WHO GVCR 2017)

Lack of robust evidence to support most of Aedes vector control measures (Cochran reviews, Roiz et al 2019)



Lack of investment in new insecticides, increase environmental & and regulatory constraints, aversion of citizen to the use of PHPs, etc

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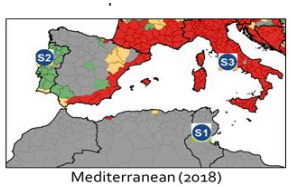
Integrated Aedes Management (IAM)

PLOS NEGLECTED TROPICAL DISEASES

REVIEW

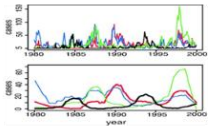
Integrated *Aedes* management for the control of *Aedes*-borne diseases

A portfolio of operational actions tailored to different epidemiological and entomological risk scenarios

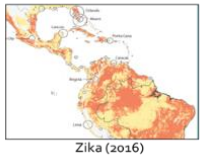


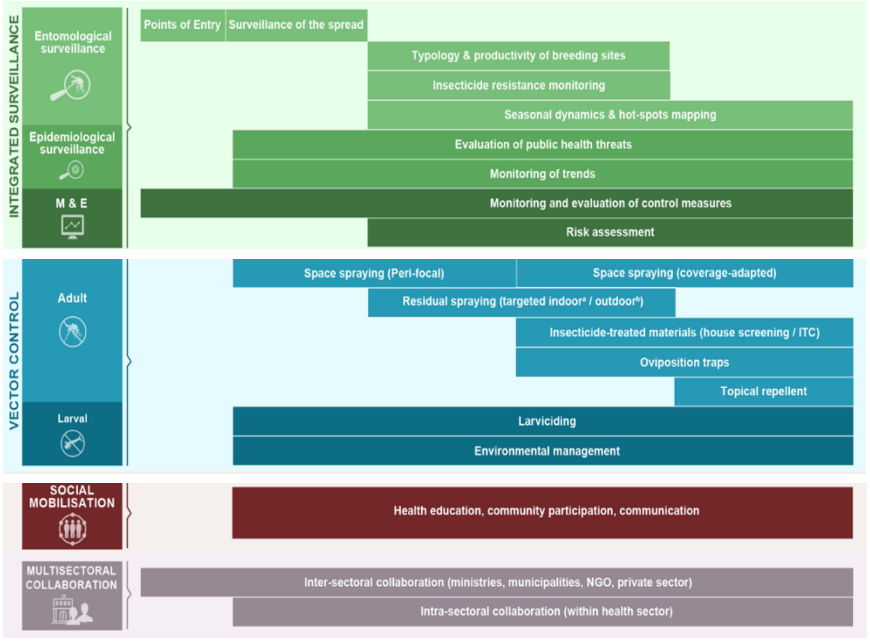
Mediterranean (2018)

S4 Endemic transmission

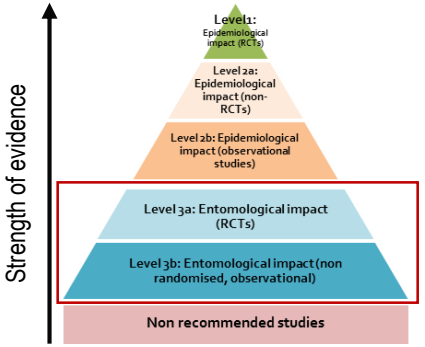

Bangkok (1980-2010)

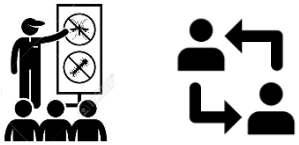
S5 Epidemic tansmission


Zika (2016)



Evidence base (>20 meta analysis & systematic reviews)





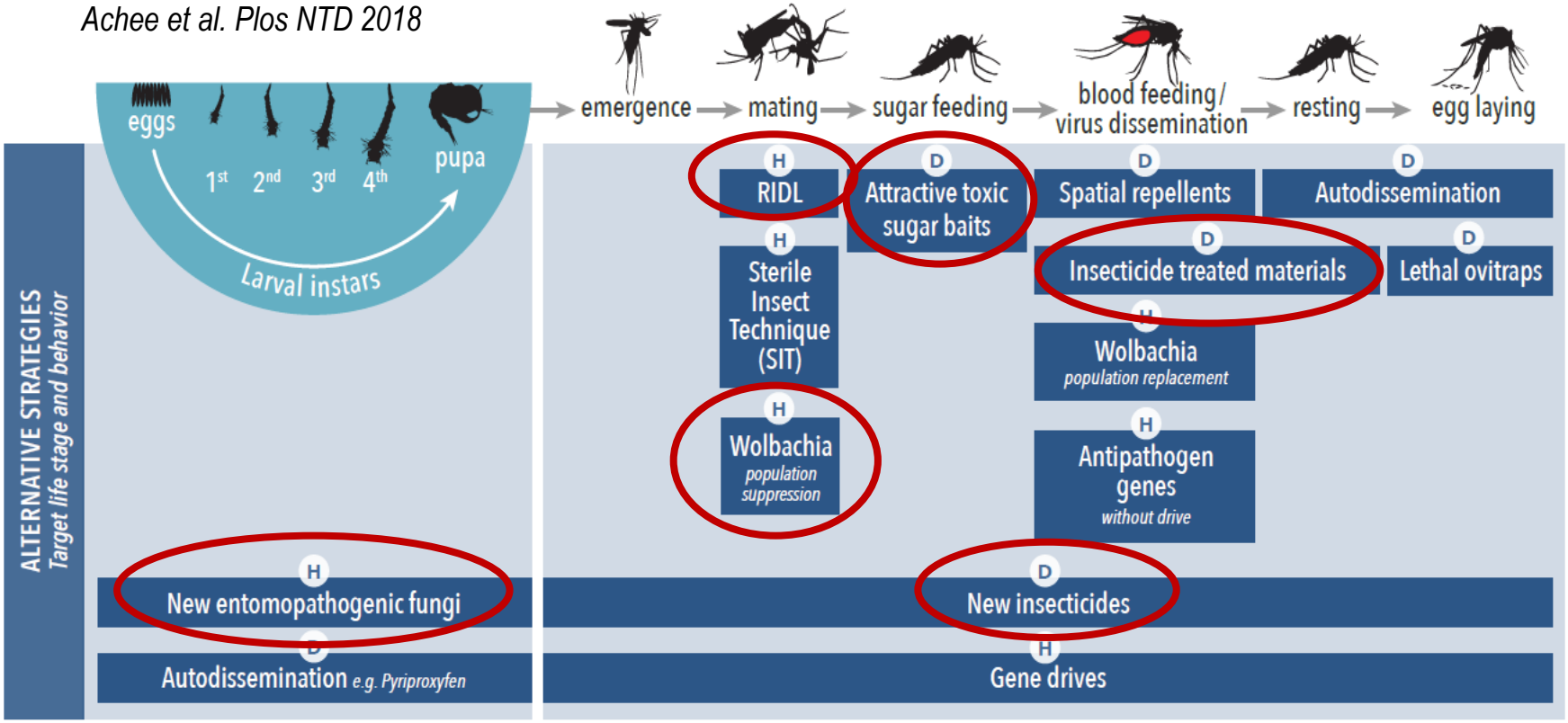
Roiz et al. *Plos NTD* 2018

Alternative strategies

PLOS | NEGLECTED TROPICAL DISEASES

REVIEW
Alternative strategies for mosquito-borne arbovirus control

Achee et al. Plos NTD 2018

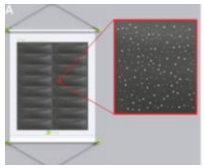


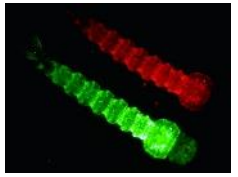
Anticipated Impact of Intervention on Resistance Mitigation

H High D Dependent on Active Ingredient



(G2, Royal guard, Sumishield, eave tubes)






Insecticide resistance management (IRM)

PLOS | NEGLECTED TROPICAL DISEASES

REVIEW

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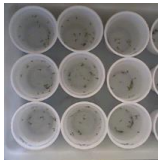
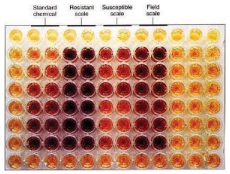
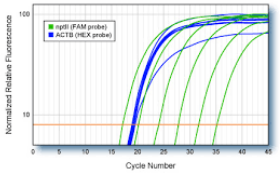
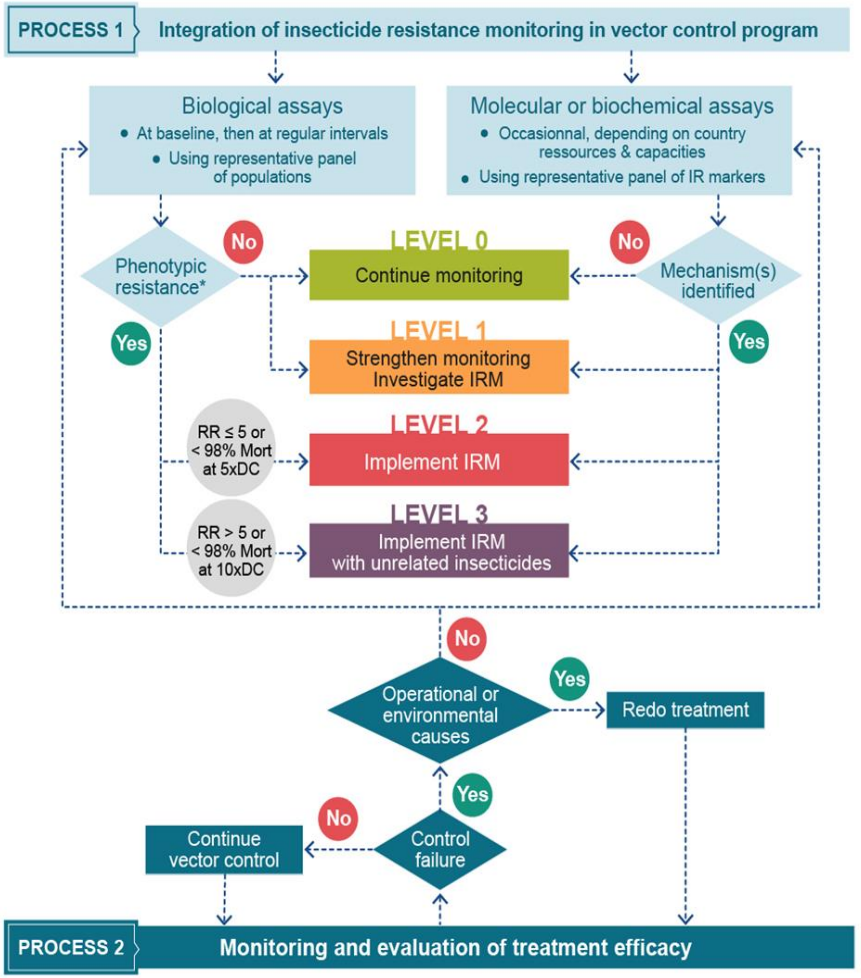
Methods for tracking insecticide resistance







Framework for implementation of IRM



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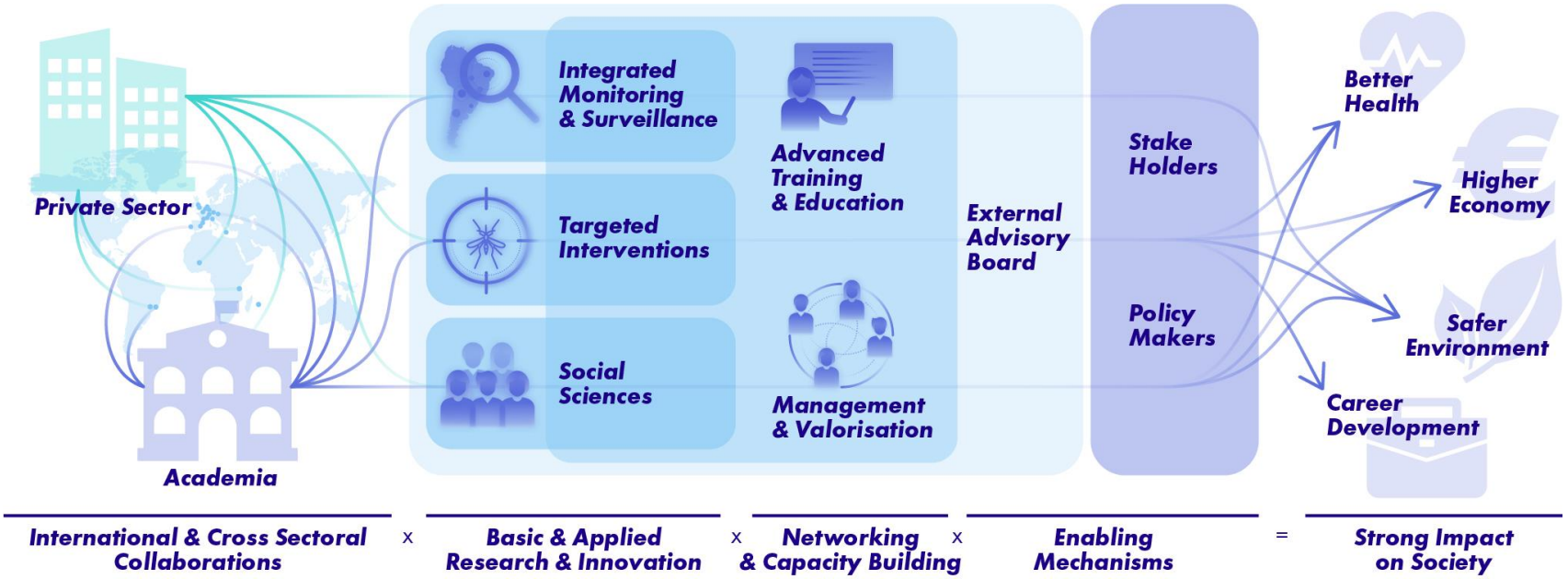
Dusfour et al. *Plos NTD* 2018

Conceptual framework of the INOVEC project



This project has received funding from the European Union HORIZON-MSCA-2021-SE-01, under the grant No 101086257