Organización Panamericana de la Salud

Organización Mundial de la Salud

OFICINA REGIONAL PARA LAS Américas

Estrategia de Gestión Integrada

para la prevención y control del Dengue en las Américas

Programa Regional de Dengue OPS/OMS

dengue

Otras tecnologías en el control del *Aedes aegypti*

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Enfermedades Desatendidas, Tropicales y Transmitidas por Vectores (VT)
OPS/OMS, Washington DC

29 de mayo, 2014

Para enfermedades tales como Dengue el control de vectores es la única forma de prevenir la transmisión.

Se ha demostrado que las intervenciones recomendadas por la OPS/OMS de control de transmisión por *Aedes aegypti,* son efectivas cuando se implementan adecuadamente.

Como ha funcionado el control de *Ae. aegypti* en las Américas

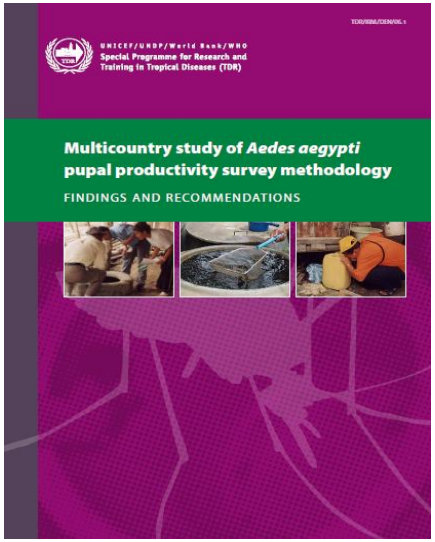
- Muchos países tienen programas de prevención y control de enfermedades transmitidas por vectores que son remanentes de los programas de erradicación de la malaria o fiebre amarilla;
- Muchos países usan el Control químico como intervención prioritaria (transmisión/densidad) ;
- Las aplicaciones espaciales y uso de larvicidas no son suficientemente evaluadas.

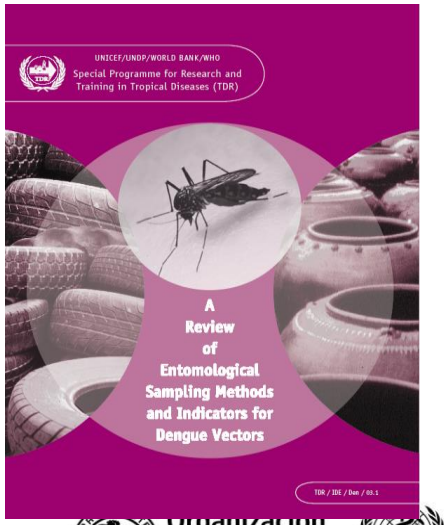
Retos para lograr efectividad en el control de la transmisión

- El incremento de la resistencia a los insecticidas y el número limitado de nuevos productos ponen en peligro la efectividad del control regular o ante brotes/epidemia;

No hay nuevos insecticidas adulticidas en salud pública en uso en los últimos 20 años

Vigilancia del *Aedes aegypti*





Levantamiento rápido para *Aedes aegypti* (LIRAa)

Características

- identifican los criaderos predominantes y obtiene los índices tradicionales (índice de viviendas, índice de Breteau e índice de recipientes, pupas);
- Realizada en un promedio de 60 días o más, una semana (LIRAa);
- generalmente proporciona índices para grandes áreas (barrios) o estratos (LIRAa);
- dirige las actividades de control;

Nuevas tecnologías para la vigilancia del *Aedes aegypti*

MosquiTRAP

Trampa BGS

AdulTRAP

Ovitrampa

D-vac

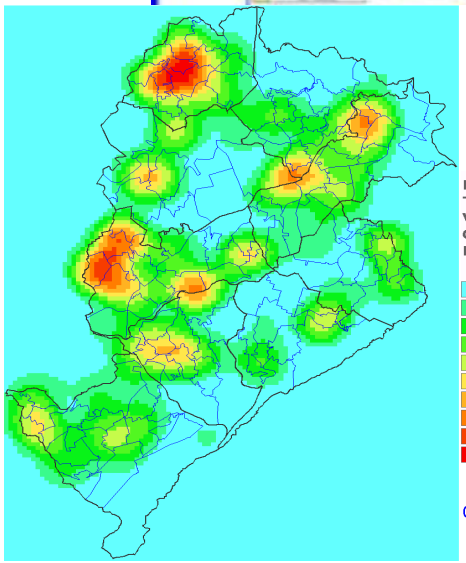
Autocida Gravid Ovitrap (AGO)

Trampas letales

Componentes:

- Colores de cuerpo de la trampa y el tamaño son visualmente atractivas para los mosquitos
- La trampa contiene agua con una mezcla de 4 especies de bacterias que emiten un olor atractivo para las hembras
- El depósito contiene también un larvicida, spinosad, que ha sido aprobado para uso en agua potable de la OMS
- Recubre el interior de la trampa es un tejido de malla tratado con un adulticida piretroides, Alfa Cipermetrina (hecho de LLIN DuraNet ®)

Nuevos dispositivos para recolección/análisis de la información en terreno para la vigilancia y control del *Aedes aegypti*



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Medical and Veterinary Entomology (2008) **22**, 203–221

REVIEW ARTICLE

Effect of dengue vector control interventions on entomological parameters in developing countries: a systematic review and meta-analysis

T. E. ERLANGER[1], J. KEISER[2] and J. UTZINGER[1]
[1]Department of Public Health and Epidemiology and [2]Department of Medical Parasitology and Infection Biology, Swiss Tropical Institute, Basel, Switzerland

- **Manejo integrado de vectores fue encontrado como el método más eficaz para reducir la IR, IV y IB, resultando en valores relativa efectividad combinada de 0.12 (c.i. 95 0.02 – 0,62), 0,17 (c.i. 95 0.02 – 1,28) y 0.33 (c.i. 95 0.22 – 0,48), respectivamente**

- **Manejo ambiental mostró una efectividad relativamente baja de 0,71 (c.i. 95 0.55 – 0,90) para el IB, 0.49 (c.i. 95 0.30 – 0,79 para la IR) y 0.43 (c.i. 95 0.31 – 0,59) para el IV.**

- **Control biológico (efectividad relativa para la IR: 0.18) generalmente dirigidos a un pequeño número de personas (tamaño mediana de la población: 200; 20 – 2500), mientras que el manejo integrado de vectores se centró en las poblaciones más grandes (mediana: 12 450; rango: 210 – 9 600 000).**

Recipientes a prueba de mosquitos

3millones de capas
Brasil

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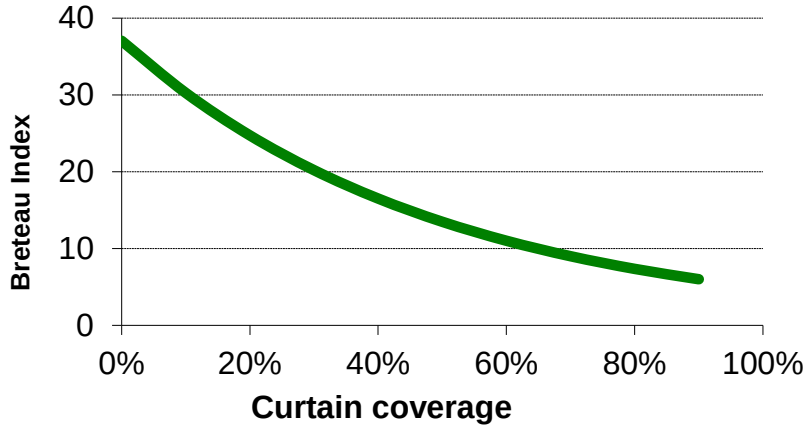
Avaliação da efetividade da utilização da metodologia Communication and Marketing Integrated for Behaviour Impact - COMBI para controle da dengue em duas localidades do Brasil
by Braga, Ivenise Leal, 2011

Material impregnados con insecticida

The effectiveness of insecticide treated curtains for *Aedes* control in Valera, Venezuela (Vanlerberghe *et al*.,2009)

Modeled effect of ITC coverage



*"**Cobertura inicial alta**, descenso rápido a largo plazo en escenarios sin actividades de promoción o comunicación"*

*"Las cortinas pueden **reducir los índices**, pero el efecto **depende de la cobertura poblacional**, y si la cobertura esta muy baja el efecto desaparece"*

Control Biológico

Betta splendens

EVALUATION OF THE IMPACT ON *AEDES AEGYPTI* INFESTATION IN CEMENT TANKS OF THE MUNICIPAL DISTRICT OF CANINDÉ, CEARÁ, BRAZIL AFTER USING THE *BETTA SPLENDENS* FISH AS AN ALTERNATIVE BIOLOGICAL CONTROL. Rev. Soc. Bras. Med. Trop. vol.37 no.5 Uberaba Sept./Oct. 2004

CONTROL OF AEDES AEGYPTI LARVAE IN HOUSEHOLD WATER CONTAINERS BY CHINESE CAT FISH. Bull World Health Organ. 1987; 65(4): 503–506

Mesocyclops

ELIMINATION OF DENGUE BY COMMUNITY PROGRAMS USING *MESOCYCLOPS*(COPEPODA) AGAINST *AEDES AEGYPTI* IN CENTRAL VIETNAM

VU SINH NAM, NGUYEN THI YEN, TRAN VU PHONG, TRUONG UYEN NINH, LE QUYEN MAI, LE VIET LO, LE TRUNG NGHIA, AHMET BEKTAS, ALISTAIR BRISCOMBE, JOHN G. AASKOV, PETER A. RYAN, AND BRIAN H. KAY

Am. J. Trop. Med. Hyg., 72(1), 2005, pp. 67-73

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Am. J. Trop. Med. Hyg., 82(6), 2010, pp. 1053–1059
doi:10.4269/ajtmh.2010.09-0603

Bacillus thuringiensis var. *israelensis* (Bti) Provides Residual Control of *Aedes aegypti* in Small Containers

Scott A. Ritchie,* Luke P. Rapley, and Seleena Benjamin

School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Cairns, Queensland, 4870 Australia; Public Health, Valent BioSciences Corporation, Singapore

Abstract. We examined the use of megadoses of VectoBac WG for residual control of *Aedes aegypti* in 2-L plastic buckets. Doses of 10×, 20×, and 50× the recommended rate of 8 mg/L provided ≥ 90% control for 8, 8, and 23 weeks, respectively. There was no significant difference in mortality between dry (neat) or aqueous mixture of VectoBac WG. Pretreatment of dry containers up to 8 weeks before flooding did not significantly decrease efficacy through 11 success weeks. Thus, megadoses of dry formulations of Bti can be used for residual control of *Ae. aegypti* in small containers. Furthermore, these doses use small amounts of product (0.08–0.4 g/L) that is more practical to measure than the minute amounts (0.008 g/L) required by the recommended rate, and cost US$2.18 to treat 50 Cairns yards containing an average total of 80 containers. This method could also be used to control *Aedes albopictus*.

African Entomology 21(2):349-353. 2013
doi: http://dx.doi.org/10.4001/003.021.0206

Effectiveness of Slow-Release Tablet Formulations of the IGR Diflubenzuron and the Bioinsecticide Spinosad Against Larvae of *Aedes aegypti* (L.)

M.S. Saleh *, O.A. Abuzinadah , Kh.M. Al-Ghamdi , A.A. Alsagaf & J.A. Mahyoub

Department of Biological Science, Faculty of Science, King Abdul-Aziz University, Jeddah, Saudi Arabia

* Author for correspondence. E-mail: diptera2012@gmail.com

The larvicidal effectiveness of slow-release tablet formulations of the chitin synthesis inhibitor Dudim® (diflubenzuron) and the bioinsecticide Natular™ (spinosad) against mosquito larvae of *Aedes aegypti* (L.) has been evaluated. The results showed that the test formulations provided long-term residual control against the larvae. Effective control giving 90–100 % inhibition of adult emergence was achieved for 10 weeks post-treatment for diflubenzuron and 7 weeks for spinosad. In addition, larval treatments with slow-release diflubenzuron formulations led to a marked prolongation in the time needed for blood meal digestion and a reduction in the reproductive potential of adult survivors. On the other hand, larval treatments with slow-release formulations of spinosad tablets affect neither the time of blood meal digestion nor the reproductive capacity of mosquito adults that emerged from surviving larvae.

Journal of the American Mosquito Control Association, 26(1):67–87, 2010

A REVIEW OF SPINOSAD AS A NATURAL PRODUCT FOR LARVAL MOSQUITO CONTROL

MARK B. HERTLEIN,[1] COSTAS MAVROTAS,[2] CHRISTIAN JOUSSEAUME,[3] MICHAEL LYSANDROU,[2] GARY D. THOMPSON,[1] WILLIAM JANY[4] AND SCOTT A. RITCHIE[5]

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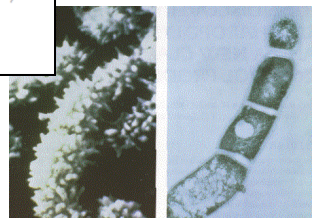
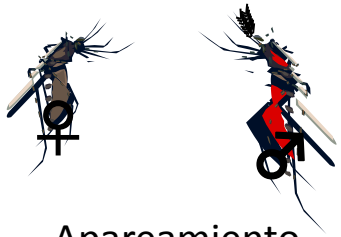


EFFICACY OF AQUATAIN, A MONOMOLECULAR FILM, FOR THE CONTROL OF MALARIA VECTORS IN RICE PADDIES (2011)

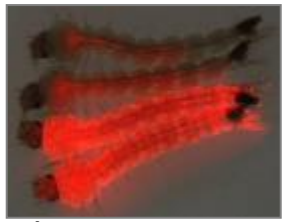
Tullu Bukhari, Willem Takken,Andrew K. Githeko,Constantianus J. M. Koenraadt

PLoS ONE 6(6): e21713. doi:10.1371/journal.pone.0021713

Mosquitos genéticamente modificados



Apareamiento

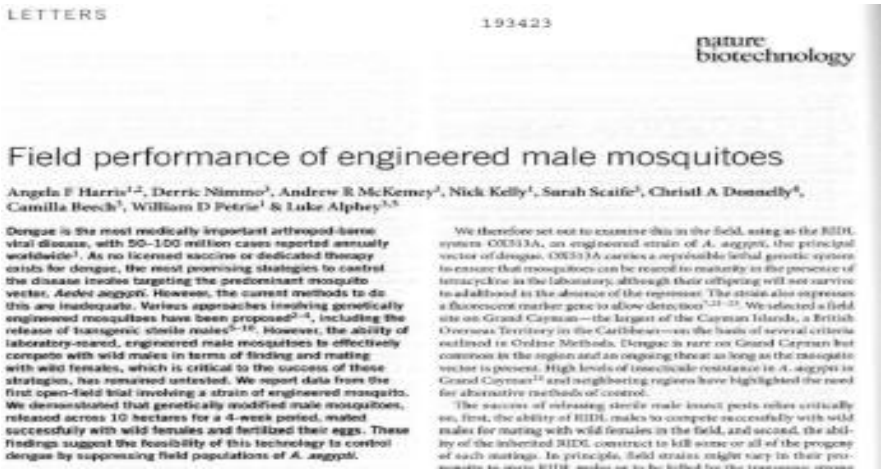


Larvas mueren en estadio temprano

No existe producción de adultos

No existen picaduras de hembras adultas

Reducción en la transmisión de enfermedad



LETTERS

193423

nature biotechnology

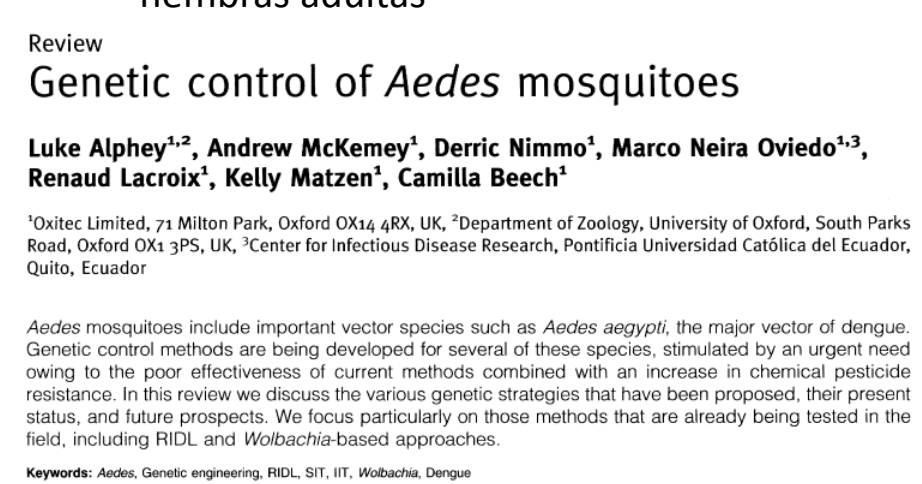
Field performance of engineered male mosquitoes

Angela F Harris[1,2], Derric Nimmo[3], Andrew R McKemey[3], Nick Kelly[1], Sarah Scaife[3], Christl A Donnelly[4], Camilla Beech[3], William D Petrie[1] & Luke Alphey[1,5]

Dengue is the most medically important arthropod-borne viral disease, with 50–100 million cases reported annually worldwide[1]. As no licensed vaccine or dedicated therapy exists for dengue, the most promising strategies to control the disease involve targeting the predominant mosquito vector, *Aedes aegypti*. However, the current methods to do this are inadequate. Various approaches involving genetically engineered mosquitoes have been proposed[2–4], including the release of transgenic sterile males[5–10]. However, the ability of laboratory-reared, engineered male mosquitoes to effectively compete with wild males in terms of finding and mating with wild females, which is critical to the success of these strategies, has remained untested. We report data from the first open-field trial involving a strain of engineered mosquito. We demonstrated that genetically modified male mosquitoes, released across 10 hectares for a 4-week period, mated successfully with wild females and fertilized their eggs. These findings support the feasibility of this technology to control dengue by suppressing field populations of *A. aegypti*.

We therefore set out to examine this in the field, using as the RIDL system OX513A, an engineered strain of *A. aegypti*, the principal vector of dengue. OX513A carries a repressible lethal genetic system to ensure that mosquitoes can be reared to maturity in the presence of tetracycline in the laboratory, although their offspring will not survive to adulthood in the absence of the repressor. The strain also expresses a fluorescent marker gene to allow detection[7,11–13]. We selected a field site on Grand Cayman—the largest of the Cayman Islands, a British Overseas Territory in the Caribbean—on the basis of several criteria outlined in Online Methods. Dengue is rare on Grand Cayman but common in the region and an ongoing threat as long as the mosquito vector is present. High levels of insecticide resistance in *A. aegypti* in Grand Cayman[14] and neighboring regions have highlighted the need for alternative methods of control.

The success of releasing sterile male insect pests relies critically on, first, the ability of RIDL males to compete successfully with wild males for mating with wild females in the field, and second, the ability of the inherited RIDL construct to kill some or all of the progeny of such matings. In principle, field strains might vary in their pro-



Review

Genetic control of *Aedes* mosquitoes

Luke Alphey[1,2], Andrew McKemey[1], Derric Nimmo[1], Marco Neira Oviedo[1,3], Renaud Lacroix[1], Kelly Matzen[1], Camilla Beech[1]

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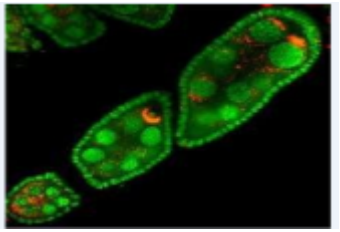
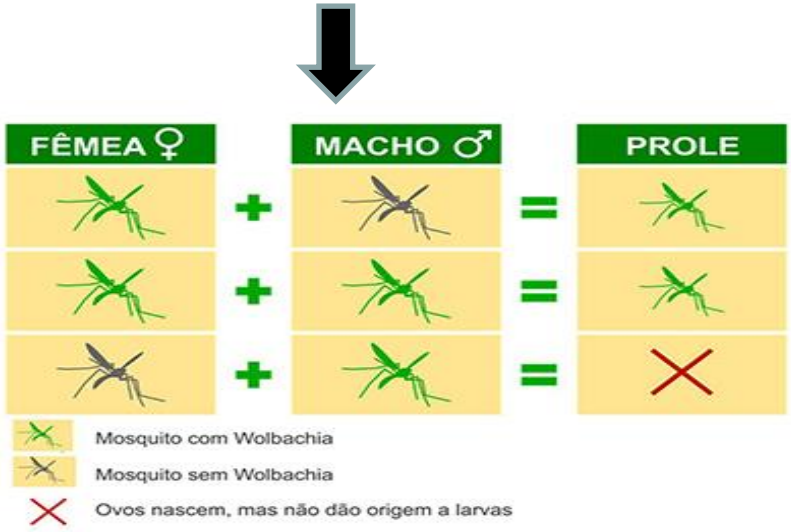
Aedes mosquitoes include important vector species such as *Aedes aegypti*, the major vector of dengue. Genetic control methods are being developed for several of these species, stimulated by an urgent need owing to the poor effectiveness of current methods combined with an increase in chemical pesticide resistance. In this review we discuss the various genetic strategies that have been proposed, their present status, and future prospects. We focus particularly on those methods that are already being tested in the field, including RIDL and *Wolbachia*-based approaches.

Keywords: *Aedes*, Genetic engineering, RIDL, SIT, IIT, *Wolbachia*, Dengue

Aedes & Wolbachia





ELIMINAR LA DENGUE

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le la Salud

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Stable Introduction of a Life-Shortening *Wolbachia* Infection into the Mosquito *Aedes aegypti*

Conor J. McMeniman,[1] Roxanna V. Lane,[1] Bodil N. Cass,[1] Amy W.C. Fong,[1] Manpreet Sidhu,[1] Yu-Feng Wang,[1,2] Scott L. O'Neill[1]*

Most pathogens require a relatively long period of development in their mosquito vector before they can be transmitted to a new human host; hence, only older insects are of epidemiological importance. The successful transfer of a life-shortening strain of the inherited bacterial symbiont, *Wolbachia*, into the major mosquito vector of dengue, *Aedes aegypti*, halved adult life span under laboratory conditions. The association is stable, and the *Wolbachia* strain is maternally inherited at high frequency. It is capable of inducing complete cytoplasmic incompatibility, which should facilitate its invasion into natural field populations and its persistence over time. Our data suggest that targeting mosquito age with inherited *Wolbachia* infections may be a viable strategy to reduce the transmission of pathogens such as dengue viruses.

The control of dengue primarily targets *Aedes aegypti*, a domesticated mosquito that prefers to live in and around human habitation (*1*). With few exceptions, dengue management strategies have been complicated by the inability to completely eradicate *A. aegypti* from urban settings and the ineffective application of long-lasting vector-control programs (*2*). This has led to a worldwide resurgence of dengue and has highlighted the urgent need for novel and sustainable disease-control strategies.

Most pathogens that are transmitted by mosquitoes share a common property; they have to undergo a significant period of development in their insect vector before they can be transmitted to a new host. After a female mosquito ingests an

OPEN ACCESS Freely available online PLoS PATHOGENS

The Endosymbiotic Bacterium *Wolbachia* Induces Resistance to Dengue Virus in *Aedes aegypti*

Guowu Bian[1], Yao Xu[1], Peng Lu[1], Yan Xie[2], Zhiyong Xi[1]*

1 Department of Entomology and Genetics Program, Michigan State University, East Lansing, Michigan, United States of America, 2 Center for Statistical Training & Consulting, Michigan State University, East Lansing, Michigan, United States of America

Abstract

Genetic strategies that reduce or block pathogen transmission by mosquitoes have been proposed as a means of augmenting current control measures to reduce the growing burden of vector-borne diseases. The endosymbiotic bacterium *Wolbachia* has long been promoted as a potential vehicle for introducing disease-resistance genes into mosquitoes, thereby making them refractory to the human pathogens they transmit. Given the large overlap in tissue distribution and intracellular localization between *Wolbachia* and dengue virus in mosquitoes, we conducted experiments to characterize their interactions. Our results show that *Wolbachia* inhibits viral replication and dissemination in the main dengue vector, *Aedes aegypti*. Moreover, the virus transmission potential of *Wolbachia*-infected *Ae. aegypti* was significantly diminished when compared to wild-type mosquitoes that did not harbor *Wolbachia*. At 14 days post-infection, *Wolbachia* completely blocked dengue transmission in at least 37.5% of *Ae. aegypti* mosquitoes. We also observed that this *Wolbachia*-mediated viral interference was associated with an elevated basal immunity and increased longevity in the mosquitoes. These results underscore the potential usefulness of *Wolbachia*-based control strategies for population replacement.

World Health Organization

VECTOR CONTROL ADVISORY GROUP

Operational procedures

The World Health Organization (WHO) has established a Vector Control Advisory Group (VCAG) on New Tools to serve as an advisory body to WHO on new forms of vector control for malaria and other vector-borne diseases.

Functions

The VCAG has the following functions:

1. To review and assess the public health value, "proof of principle" (epidemiological impact) of new tools, paradigms, approaches and technologies; and

2. To make recommendations on their use for vector control within the context of integrated vector management in a disease or multi-disease settings.

When is a paradigm or category "new"?

A product, technology or approach is considered a new paradigm if one or more of the following conditions are met:

- An intervention or combination of interventions that protects humans against a different group of vectors or in different transmission settings (or contexts), different human populations or via a different mechanism from existing methods, e.g. an odour-baited trap or a genetically-modified insect.
- An intervention where one or more of its characteristics is sufficiently changed that entomological effect alone is not sufficient to imply epidemiological effect, e.g. a resistance-breaking bednet.
- When a product is not adequately described by an existing target product profile (TPP) and validation will result in the development of a new TPP, and hence a new product class.

Recomendaciones

- El control químico adecuadamente implementado sigue siendo necesario para el control de la transmisión, pero dentro del marco de la EGI dengue;

- Lo levantamiento de índices larvarios y de pupas siguen siendo los métodos principales de vigilancia;

- Sistematizar y documentar las nuevas alternativas ya aprobadas para su uso;

- Las nuevas alternativas de vigilancia y control deben seguirse estudiando para generar mayores evidencias (costo/efectividad/sostenibilidad) que suporten su introducción como alternativas a los programas.

Obrigado

Thank you

Gracias