

# AVANCES EN EL CONTROL BIOLÓGICO DEL DENGUE CON EL USO DE LA BACTERIA WOLBACHIA EN COLOMBIA

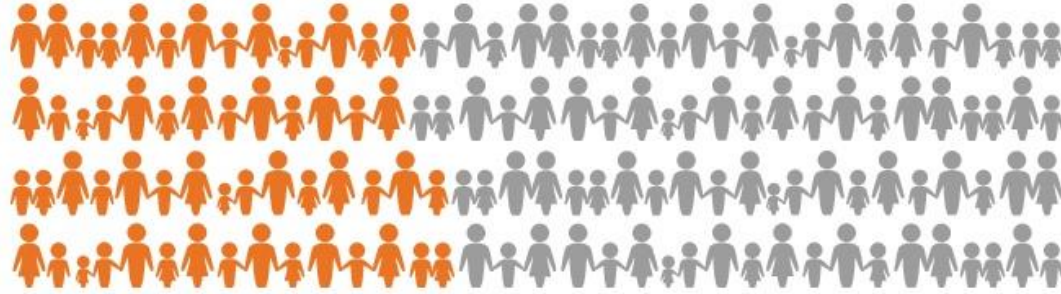


**World  
Mosquito  
Program™**



**UNIVERSIDAD  
DE ANTIOQUIA**

**IVAN DARIO VELEZ MD PhD  
Director PECET**



# 40%

de la población mundial está en riesgo de contraer dengue.



390 millones de infecciones de dengue cada año.



84 países están afectados por el Zika.



Cada 4 minutos un caso de chikungunya es confirmado.



**En 2016 se presentaron cerca de 100.000 casos de dengue en Colombia; 28 mil en Antioquia y 18 mil en Medellín.**





# WOLBACHIA

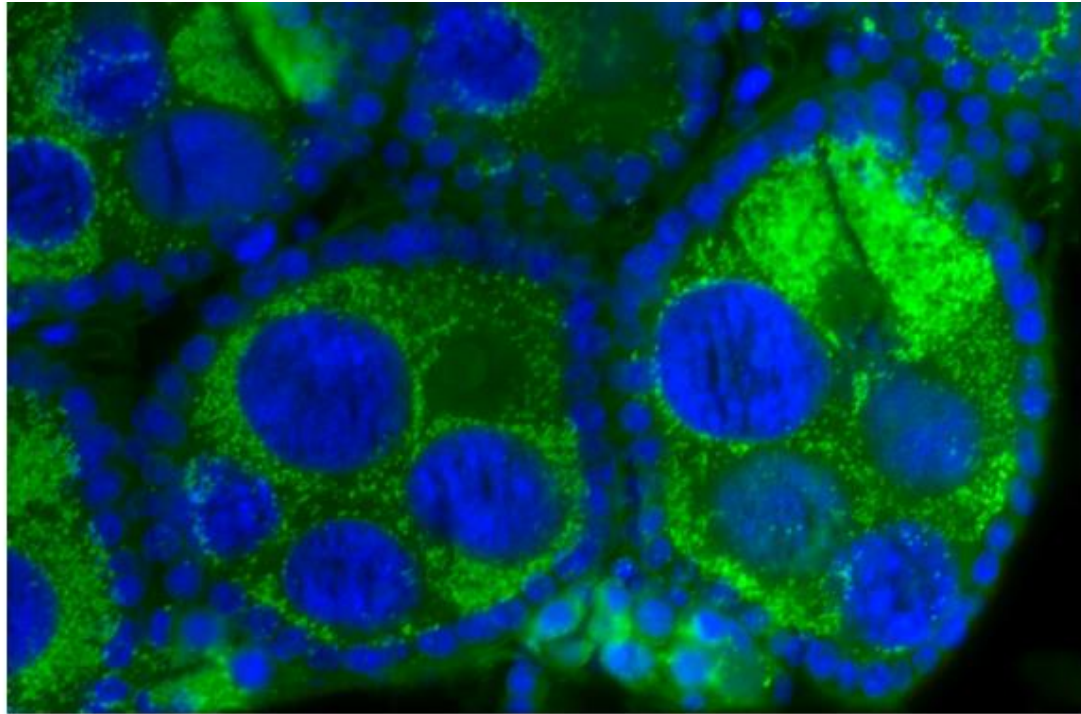


Imagen microscópica de los ovarios de un mosquito. En azul, al ADN del insecto, en verde, la bacteria 'Wolbachia'. /Itñaki Iturbe-Ormaetxe Eliminatedengue.com

**Kingdom:** Bacteria  
**Phylum:** Proteobacteria  
**Class:** Alphaproteobacteria  
**Order:** Rickettsiales ( 2 families)  
**Family:** Anaplasmataceae (4 genus)  
**Genus:** *Wolbachia* (3 species)  
**Type species:** *W. pipientis* (1936)  
*W. melophagi*  
*W. persica* (1961)

## *Wolbachia* spp.

- **Obligate intracellular bacteria (Symbiont)**
- **Maternally transmitted**
- **It is all major insect orders**
- **Not culturable outside of host**
- **Is compatible with a broad range of hosts**
- **Produces a range of effects that can be used for disease control:**

# Nuestro método innovador

## Video

# *Wolbachia* – Seguridad Ambiental

- No hay transferencia horizontal de *Wolbachia* a los predadores de mosquitos



**Alimentación de  
Predadores**  
(arañas, peces,  
copéodos)

**PCR para  
detectar ADN de  
*Wolbachia***

- No hay transferencia horizontal de *Wolbachia* al ambiente (e.g. suelo, plantas, milpies).
- La *Wolbachia* es una bacteria intracelular obligada y es incapaz de sobrevivir por fuera del hospedero.

# De que virus protege?

- **DENGUE...4 SEROTIPOS**
- **ZIKA**
- **CHIKUNGUNYA**
- **FIEBRE AMARILLA**
- **WEST NILE**
- **MAYARO**

## PUBLICACIONES QUE RESPALDAN LA INVESTIGACIÓN

### LETTER

doi:10.1038/nature10356

## Successful establishment of *Wolbachia* in *Aedes* populations to suppress dengue transmission

A. A. Hoffmann<sup>1</sup>, B. L. Montgomery<sup>2</sup>, J. Popovici<sup>2,3</sup>, I. Iturbe-Ormaetxe<sup>2,3</sup>, P. H. Johnson<sup>4</sup>, F. Muzzi<sup>2</sup>, M. Greenfield<sup>2</sup>, M. Durkan<sup>2</sup>, Y. S. Leong<sup>2</sup>, Y. Dong<sup>2,3</sup>, H. Cook<sup>2</sup>, J. Axford<sup>1</sup>, A. G. Callahan<sup>1</sup>, N. Kenny<sup>2,3</sup>, C. Omodeli<sup>4</sup>, E. A. McGraw<sup>2,3</sup>, P. A. Ryan<sup>2,3,5</sup>, S. A. Ritchie<sup>4</sup>, M. Turelli<sup>6</sup> & S. L. O'Neill<sup>2,3</sup>

OPEN ACCESS Freely available online

September 2009 | Volume 3 | Issue 9 | e516

PLOS NEGLECTED TROPICAL DISEASES

## *Wolbachia* Infection Reduces Blood-Feeding Success in the Dengue Fever Mosquito, *Aedes aegypti*

Andrew P. Turley<sup>1</sup>, Luciano A. Moreira<sup>1,2</sup>, Scott L. O'Neill<sup>1</sup>, Elizabeth A. McGraw<sup>1\*</sup>

<sup>1</sup> School of Biological Sciences, The University of Queensland, St. Lucia, Queensland, Australia, <sup>2</sup> Rene Rachou Research Institute- FIOCRUZ, Belo Horizonte, Brazil



## ***A Wolbachia Symbiont in Aedes aegypti Limits Infection with Dengue, Chikungunya, and Plasmodium***

Luciano A. Moreira,<sup>1,2</sup> Iñaki Iturbe-Ormaetxe,<sup>1</sup> Jason A. Jeffery,<sup>3</sup> Guangjin Lu,<sup>3</sup> Alyssa T. Pyke,<sup>4</sup> Lauren M. Hedges,<sup>1</sup> Bruno C. Rocha,<sup>2</sup> Sonja Hall-Mendelin,<sup>5</sup> Andrew Day,<sup>5</sup> Markus Riegler,<sup>1,6</sup> Leon E. Hugo,<sup>3</sup> Karyn N. Johnson,<sup>1</sup> Brian H. Kay,<sup>3</sup> Elizabeth A. McGraw,<sup>1</sup> Andrew F. van den Hurk,<sup>4,5</sup> Peter A. Ryan,<sup>3</sup> and Scott L. O'Neill<sup>1,\*</sup>

<sup>1</sup>School of Biological Sciences, The University of Queensland, Brisbane QLD 4072, Australia

<sup>2</sup>René Rachou Research Institute- FIOCRUZ, Belo Horizonte MG, Brazil

<sup>3</sup>Queensland Institute of Medical Research, Post Office Royal Brisbane Hospital, Brisbane QLD 4029, Australia

<sup>4</sup>Virology, Queensland Health Forensic and Scientific Services, Coopers Plains QLD 4108, Australia

<sup>5</sup>School of Chemical and Molecular Biosciences, The University of Queensland, Brisbane QLD 4072, Australia

<sup>6</sup>Present address: Centre for Plants and the Environment, School of Natural Sciences, University of Western Sydney, Penrith South DC, NSW 1797, Australia

\*Correspondence: [scott.oneill@uq.edu.au](mailto:scott.oneill@uq.edu.au)

DOI: [10.1016/j.cell.2009.11.042](https://doi.org/10.1016/j.cell.2009.11.042)

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PLOS | NEGLECTED TROPICAL DISEASES

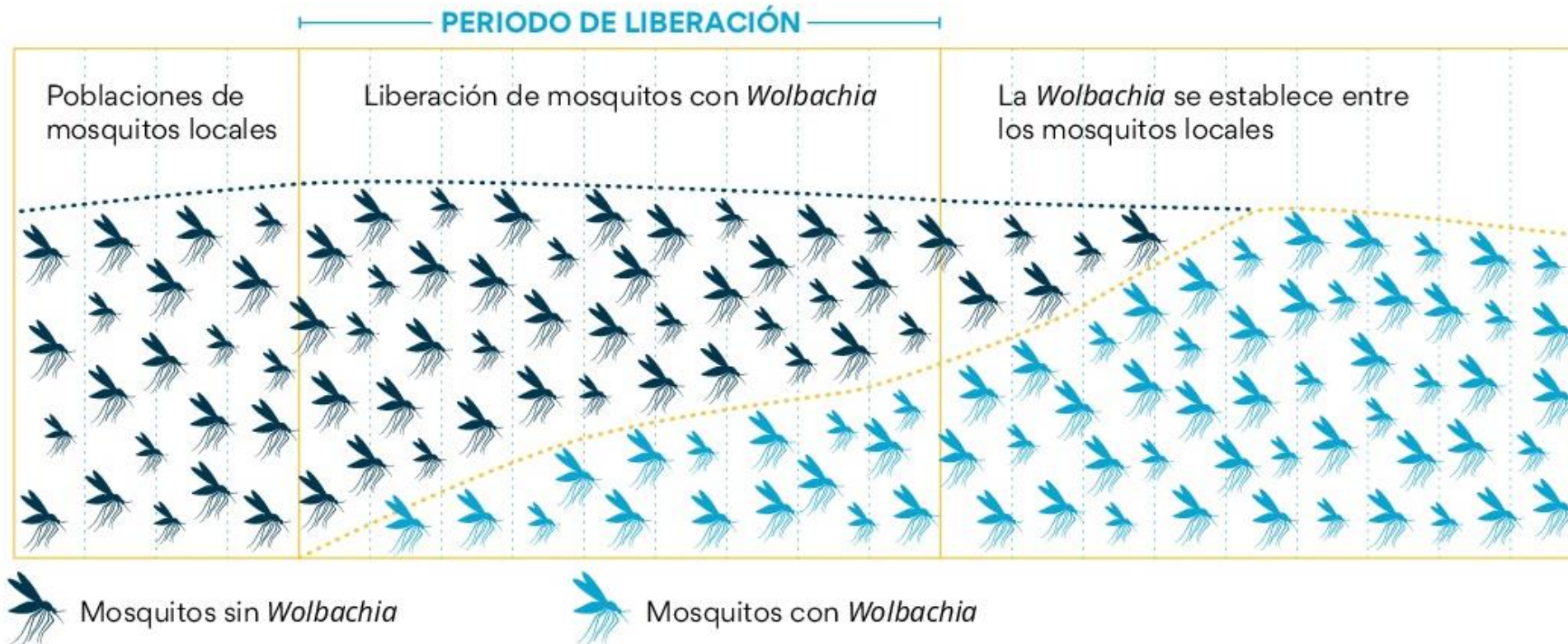
## **Impact of *Wolbachia* on Infection with Chikungunya and Yellow Fever Viruses in the Mosquito Vector *Aedes aegypti***

**Andrew F. van den Hurk<sup>1\*</sup>, Sonja Hall-Mendelin<sup>1</sup>, Alyssa T. Pyke<sup>1</sup>, Francesca D. Frentiu<sup>2,3</sup>, Kate McElroy<sup>4</sup>, Andrew Day<sup>1</sup>, Stephen Higgs<sup>4</sup>, Scott L. O'Neill<sup>2</sup>**

<sup>1</sup>Public Health Virology, Communicable Diseases Unit, Queensland Health Forensic and Scientific Services, Coopers Plains, Australia, <sup>2</sup>School of Biological Sciences, Monash University, Clayton, Australia, <sup>3</sup>Institute for Health and Biomedical Innovation, Queensland University of Technology, Kelvin Grove, Australia, <sup>4</sup>Department of Pathology, University of Texas Medical Branch, Galveston, Texas, United States of America

# ESTRATEGIA WMP

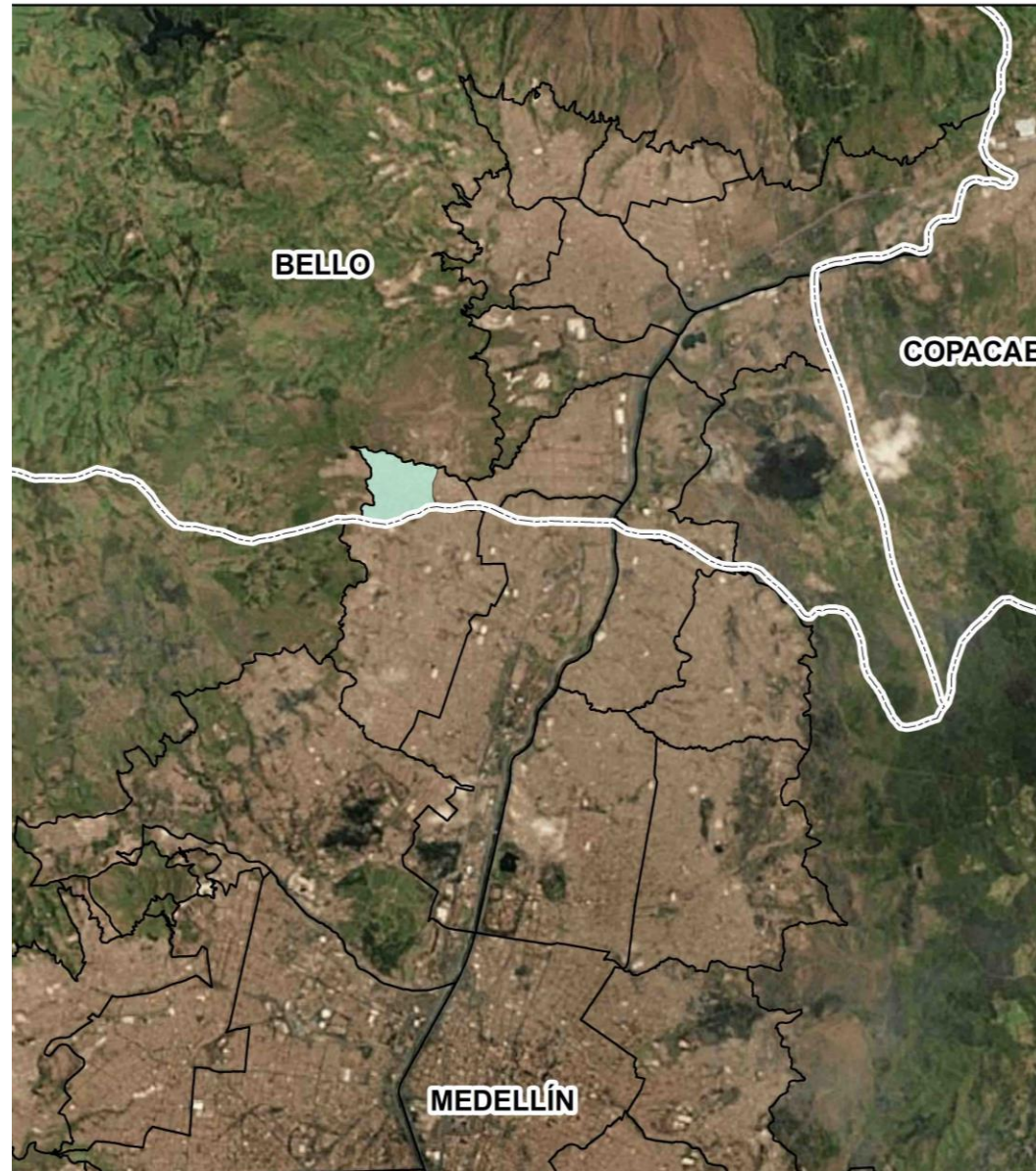
## Establecimiento de la *Wolbachia* en las comunidades de mosquitos locales





# Prueba Piloto

Objetivos

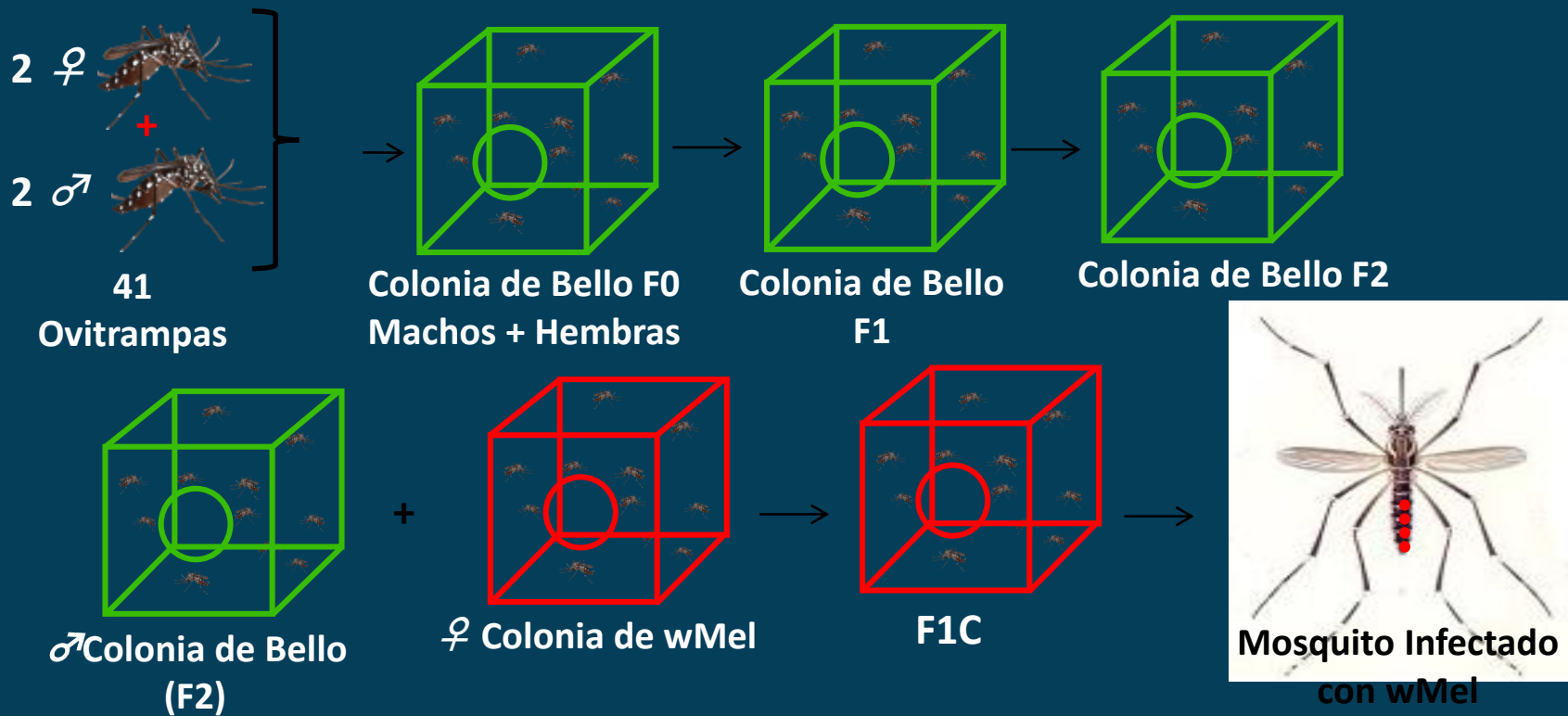


# Avales y permisos

## PRUEBA PILOTO

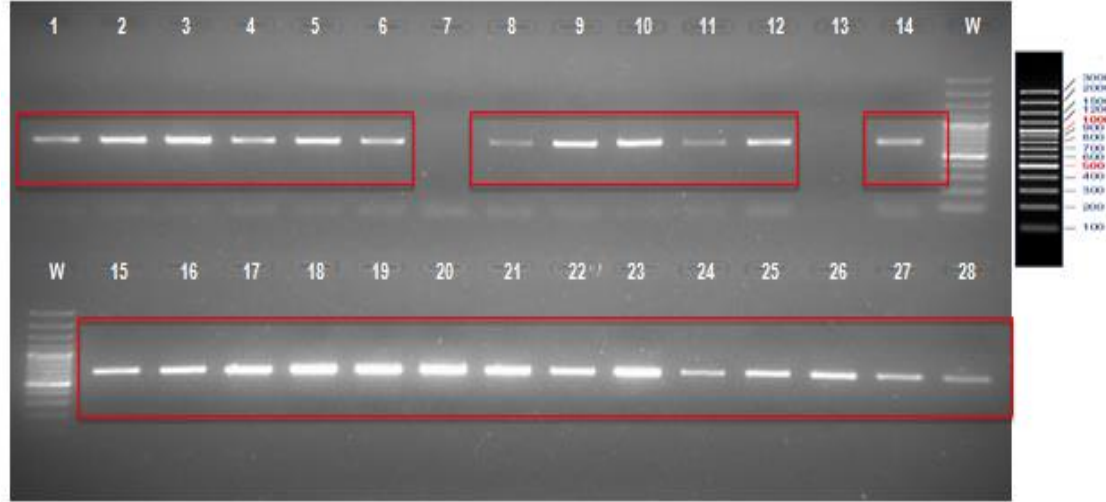
- Ministerio de Salud y Protección Social
- Ministerio de Ambiente
- Agencia de Licencias Ambientales
- Secretaría de Salud de Antioquia
- Área Metropolitana del Valle de Aburrá
- Alcaldía de Bello
- Concejo de Bello
- Secretaría de Salud de Bello
- Secretaría de Ambiente de Antioquia
- Comités de Ética de Investigación
- Corantioquia
- Consejo Departamental de Plaguicidas
- Secretaría de Salud de Medellín



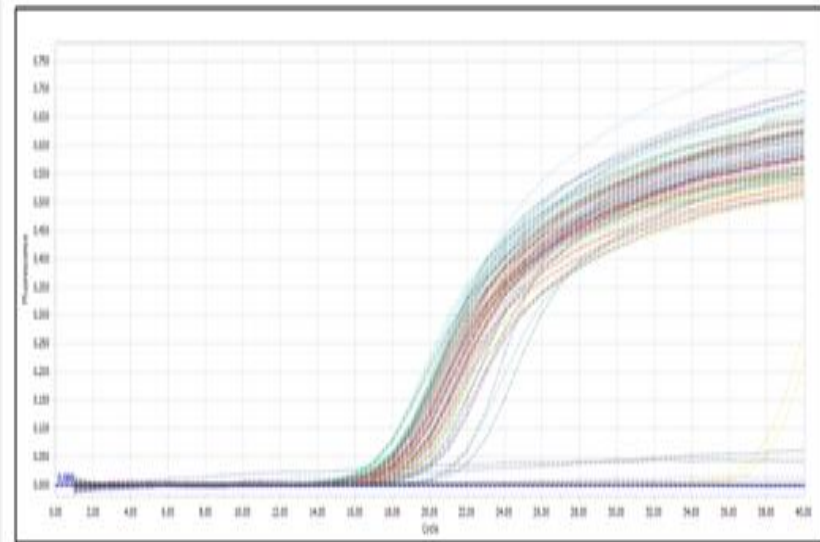
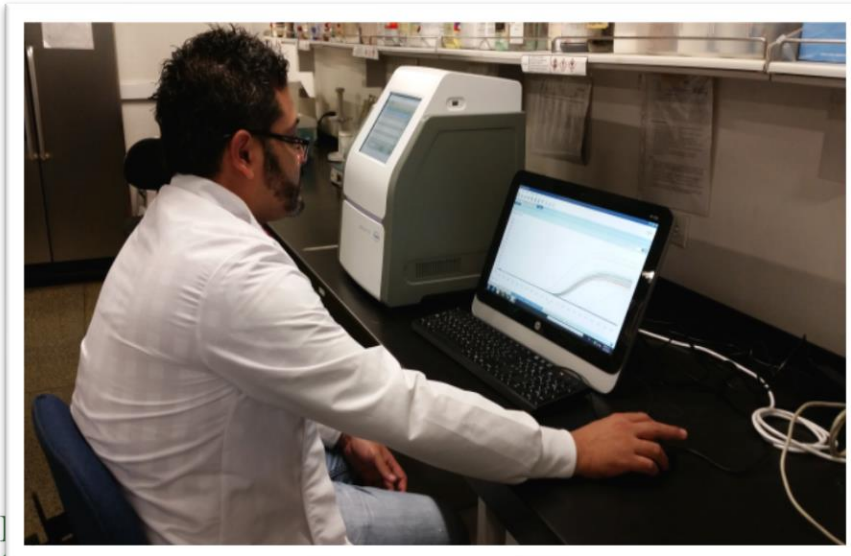


TRABAJO ENTOMOLÓGICO – Insectario – Establecimiento de colonias

# TRABAJO ENTOMOLÓGICO –



Molecular diagnosis: real time PCR for *Wolbachia*, *A. aegypti* and DENV



wMel F5  
mosquitoes

(-) Controls

World Mosquito Program™

# PUBLICACIONES

NATURE, 2016

www.nature.com/scientificreports

# SCIENTIFIC REPORTS

OPEN

## The wMel strain of *Wolbachia* Reduces Transmission of Zika virus by *Aedes aegypti*

Matthew T. Aliota<sup>1</sup>\*, Stephen A. Peinado<sup>1</sup>, Ivan Dario Velez<sup>2</sup> & Jorge E. Osorio<sup>1</sup>

Received: 28 April 2016  
Accepted: 10 June 2016

PLOS, 2016

 PLOS | NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

## The wMel Strain of *Wolbachia* Reduces Transmission of Chikungunya Virus in *Aedes aegypti*

Matthew T. Aliota<sup>1</sup>\*, Emma C. Walker<sup>1</sup>, Alexander Uribe Yepes<sup>2</sup>, Ivan Dario Velez<sup>2</sup>, Bruce M. Christensen<sup>1</sup>, Jorge E. Osorio<sup>1</sup>

<sup>1</sup> Department of Pathobiological Sciences, University of Wisconsin-Madison, Madison, Wisconsin, United States of America, <sup>2</sup> Programa de Estudio y Control de Enfermedades Tropicales (PECET), Universidad de Antioquia, Medellin, Colombia

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 OPEN ACCESS

Citation: Aliota MT, Walker EC, Uribe Yepes A, Dario Velez I, Christensen BM, Osorio JE (2016) The wMel Strain of *Wolbachia* Reduces Transmission of Chikungunya Virus in *Aedes aegypti*. PLoS Negl Trop Dis 10(4): e0004677. doi:10.1371/journal.pntd.0004677

Editor: Philip M. Armstrong, The Connecticut Agricultural Experiment Station, UNITED STATES

Received: February 25, 2016

Abstract

Background

New approaches to preventing chikungunya virus (CHIKV) are needed because current methods are limited to controlling mosquito populations, and they have not prevented the invasion of this virus into new locales, nor have they been sufficient to control the virus upon arrival. A promising candidate for arbovirus control and prevention relies on the introduction of the intracellular bacterium *Wolbachia* into *Aedes aegypti* mosquitoes. This primarily has been proposed as a tool to control dengue virus (DENV) transmission; however, evidence suggests *Wolbachia* infections confer protection for *Ae. aegypti* against CHIKV. Although this approach holds much promise for limiting virus transmission, at present our understanding of the ability of CHIKV to infect, disseminate, and be transmitted by wMel-infected *Ae. aegypti* currently being used at *Wolbachia* release sites is limited.

VIDEO

## Prueba piloto en París, Bello. Participación comunitaria





# Consentimiento informado comunitario

Casas visitadas: 5006

De acuerdo: 4744 (94,8%)

En desacuerdo: **262 (5,2%)**



# PARTICIPACION COMUNITARIA



# EPIDEMIAS TRANSMITIDAS POR *A aegypti*



## FIRST MEETING OF THE TECHNICAL ADVISORY GROUP ON PUBLIC HEALTH ENTOMOLOGY

### PAN AMERICAN HEALTH ORGANIZATION

#### SUMMARY

The first meeting of the Technical Advisory Group on Public Health Entomology (TAG PHE), was held from 8 to 10 March 2016 at the PAHO headquarters in Washington, DC. The topics discussed covered two scenarios: 1) vector control and prevention actions in regards to the current public health emergency of international concern (PHEIC) declared by WHO on the epidemic of Zika virus infections in the Americas, and 2) review and analysis of the actions that can be implemented in the medium and long term for the prevention and control of vectors responsible for vector-borne diseases (VBD) in the Americas.

- **Encourage** the rapid, robust and accelerated evaluation of new and supplemental tools for *Aedes* control, such as *Wolbachia* infections and genetically modified insect technology to ensure adequate technical cooperation and funding for this purpose.

#### MONITORING AND EVALUATION

- **Develop and provide** a protocol for penetration testing of insecticides, and testing of biological efficacy, especially in countries where the situation of insecticide resistance is unknown.
- **Evaluate** the actions of vector control, field operations, work equipment and operational procedures used in prevention and control activities; in terms of impact of actions and cost-effectiveness, and the measured impact on disease transmission and incidence. The method and evaluation of most-productive mosquito larval containers should be included.
- **The countries should support the evaluation of new tools, without losing focus on the emergency and its corresponding response to their level of scale, feasibility, cost effectiveness and acceptability by the community.**

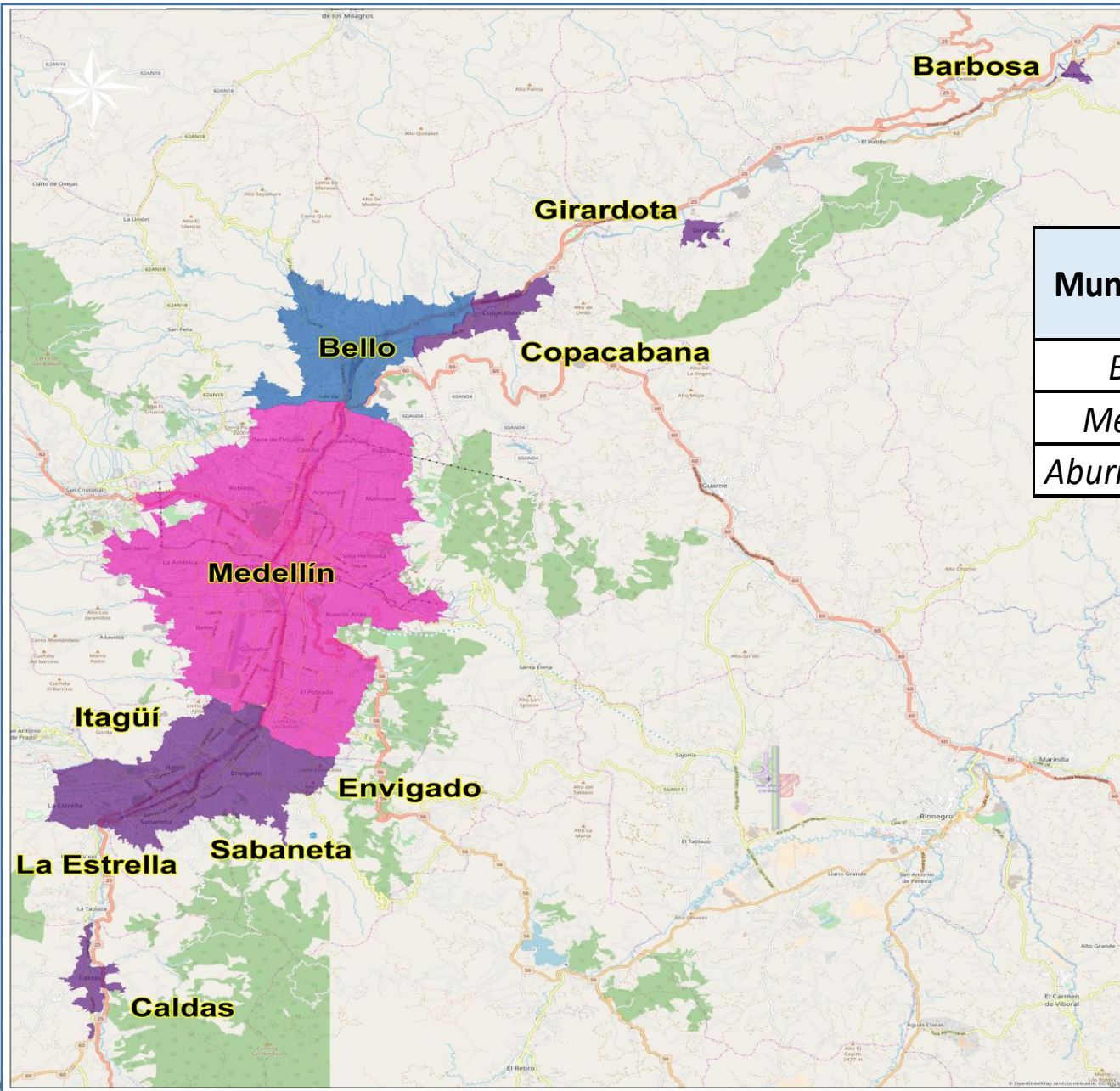


# EXPANSION COLOMBIA Y BRASIL



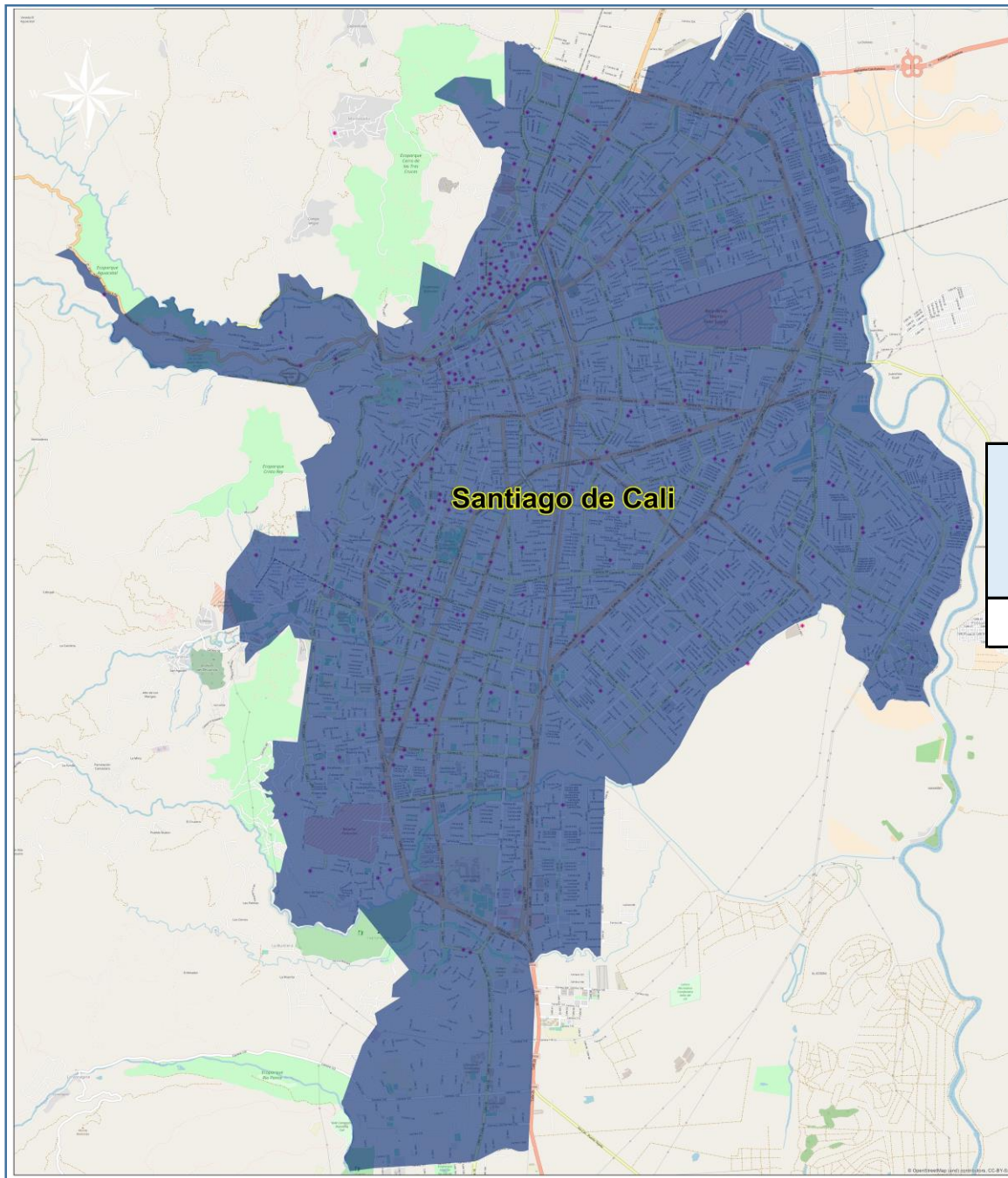


# Bello Medellín Aburrá Valley



| Municipality         | Total Urban area (Km <sup>2</sup> ) | Population  |
|----------------------|-------------------------------------|-------------|
| <i>Bello</i>         | 21,34                               | 0,5 million |
| <i>Medellín</i>      | 100,71                              | 2,5 million |
| <i>Aburra Valley</i> | 42,30                               | 0,5 million |

# Santiago de Cali



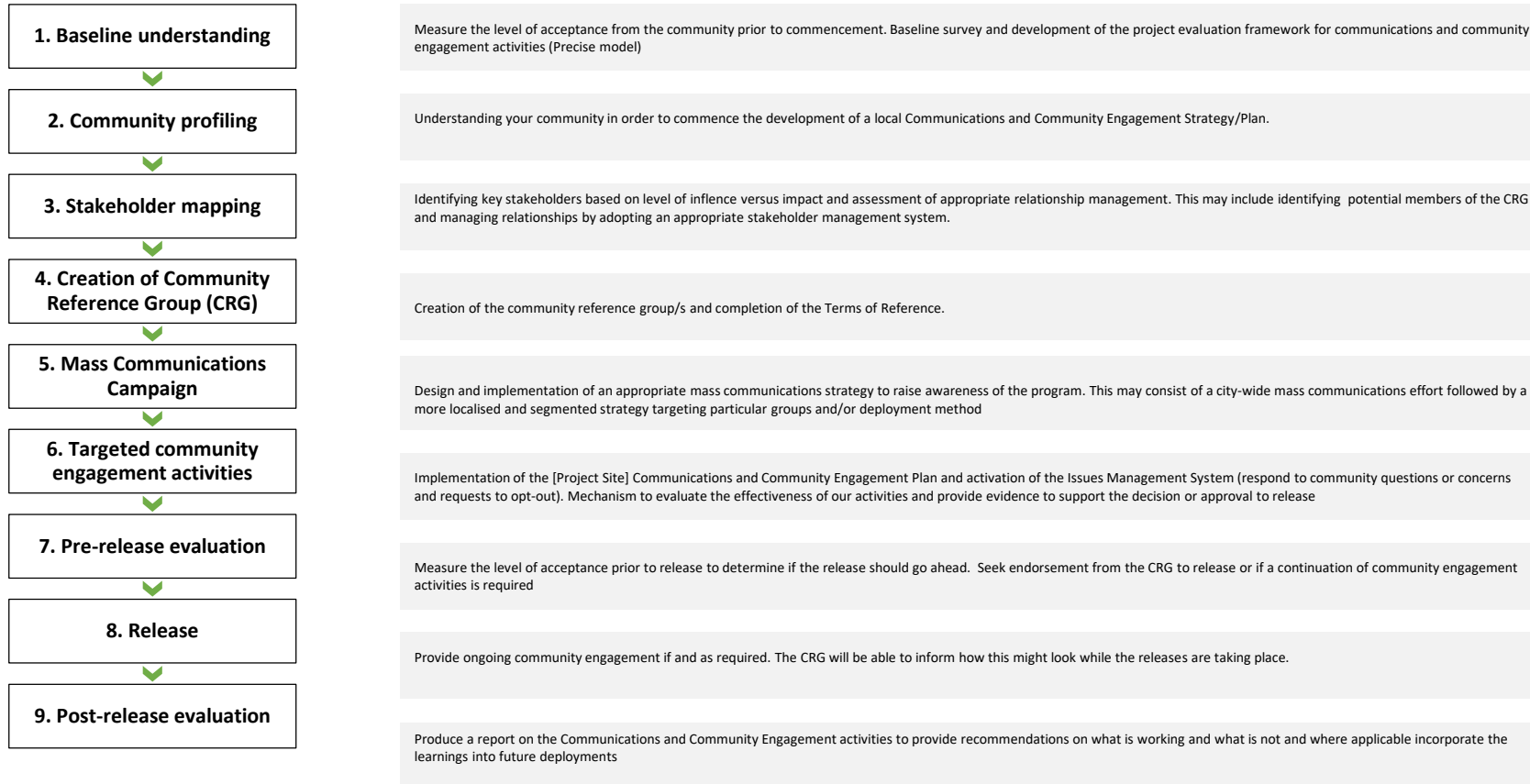
| Municipality | Total Urban area (Km <sup>2</sup> ) |
|--------------|-------------------------------------|
| <i>Cali</i>  | 120,81                              |

**Population**

**2,2 million**



# Public Acceptance Model



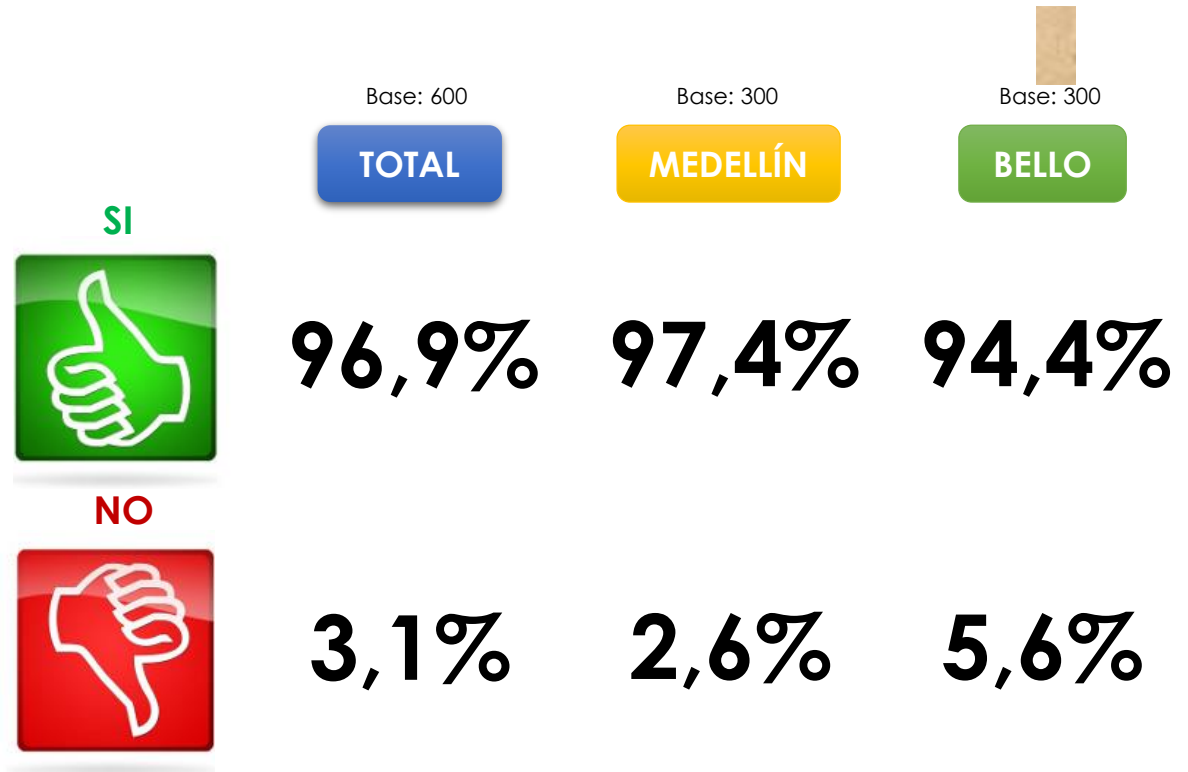


# SOCIALIZACION ADAPTADA A LA COMUNIDAD



# Aprobación de liberación de mosquitos con la bacteria *Wolbachia*

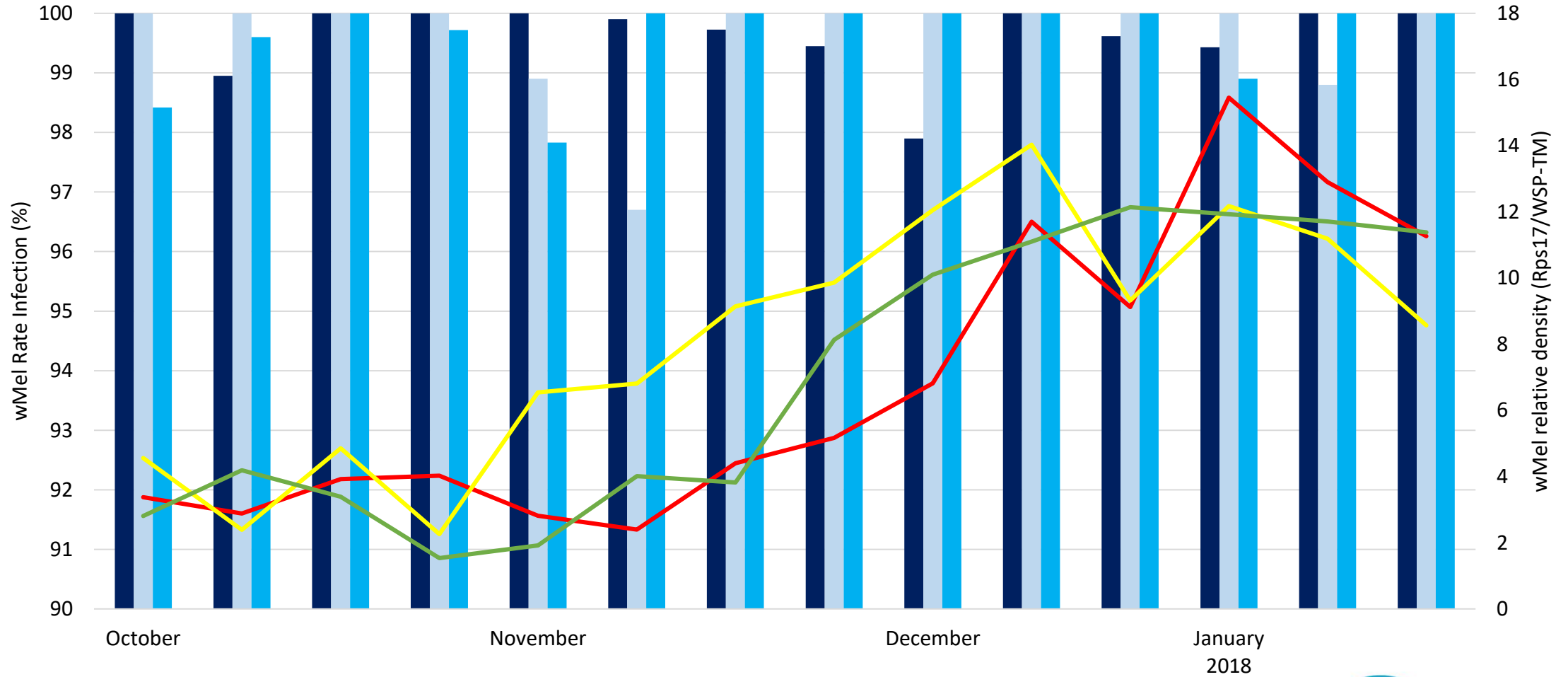
La aprobación aumenta al hacer referencia al beneficio que se obtendrá con la liberación del mosquito














# BIOFABRICA

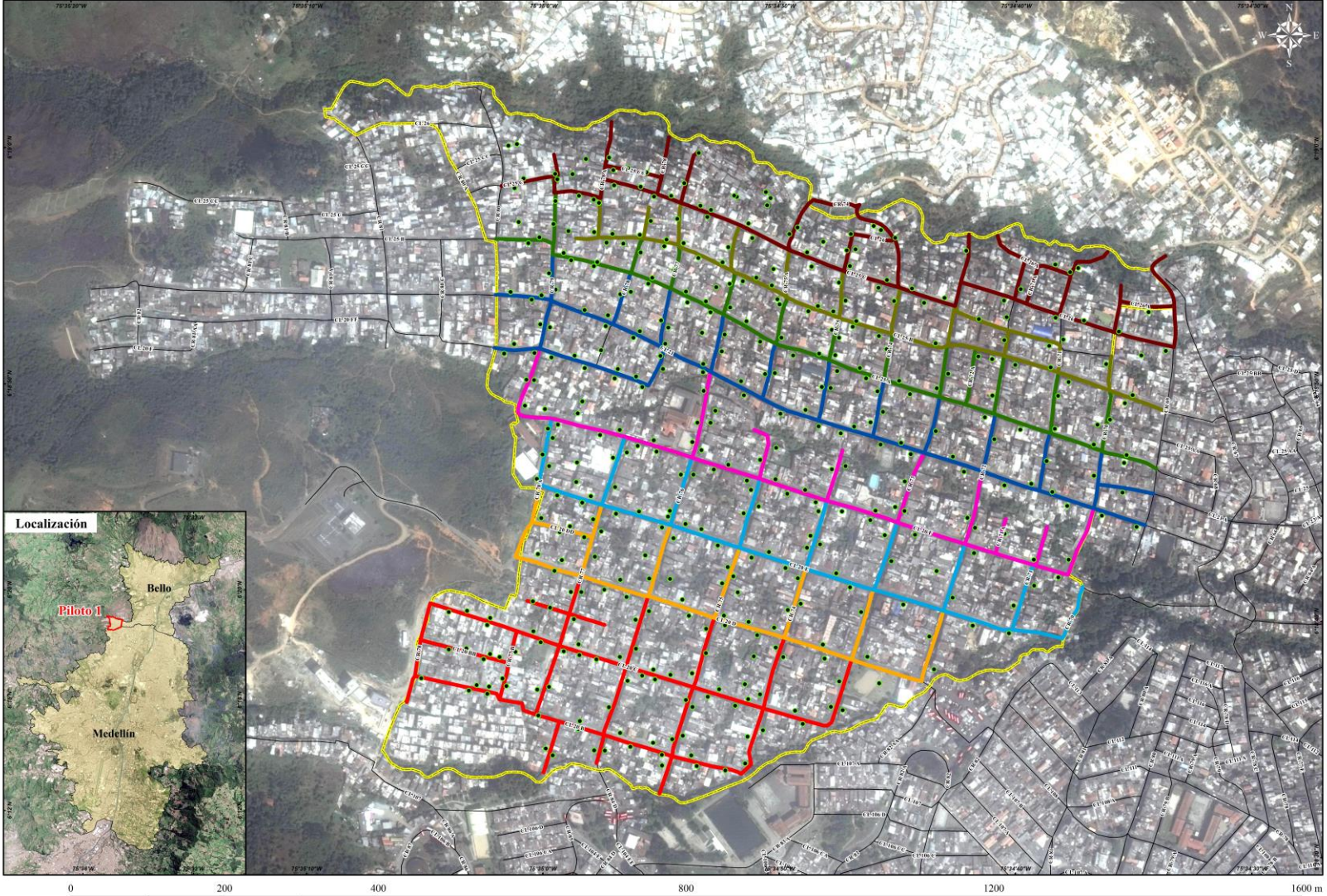


# wMel COLONY QUALITY



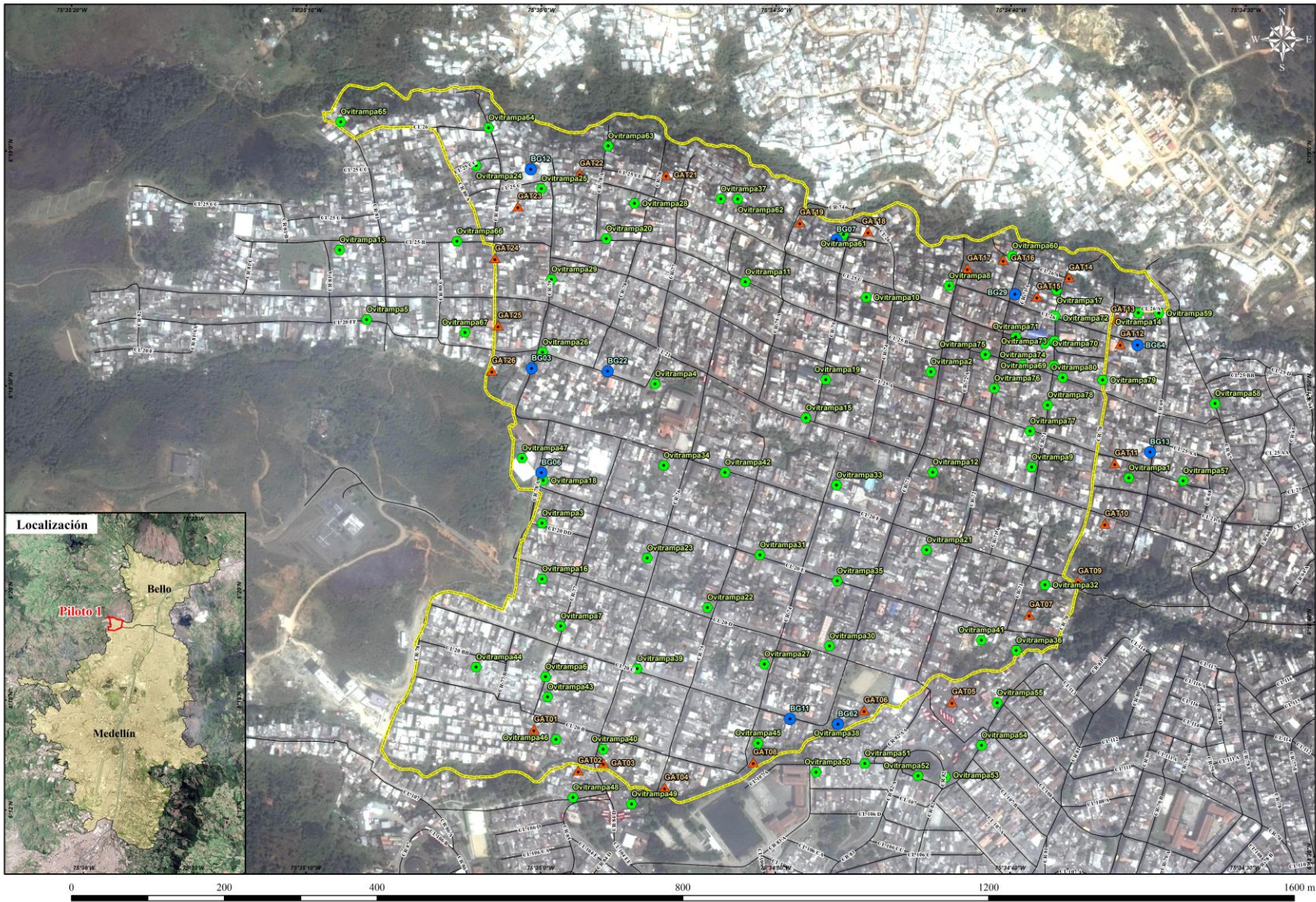
**Rutas de Liberación  
 Piloto 1**

| Simbología  |                      |
|---|----------------------|
|      | Puntos de liberación |
|    | Piloto 1             |
|    | Vías                 |
|    | Ruta 1               |
|    | Ruta 2               |
|      | Ruta 3               |
|    | Ruta 4               |
|    | Ruta 5               |
|    | Ruta 6               |
|  | Ruta 7               |
|  | Ruta 8               |



**Rutas de liberación**





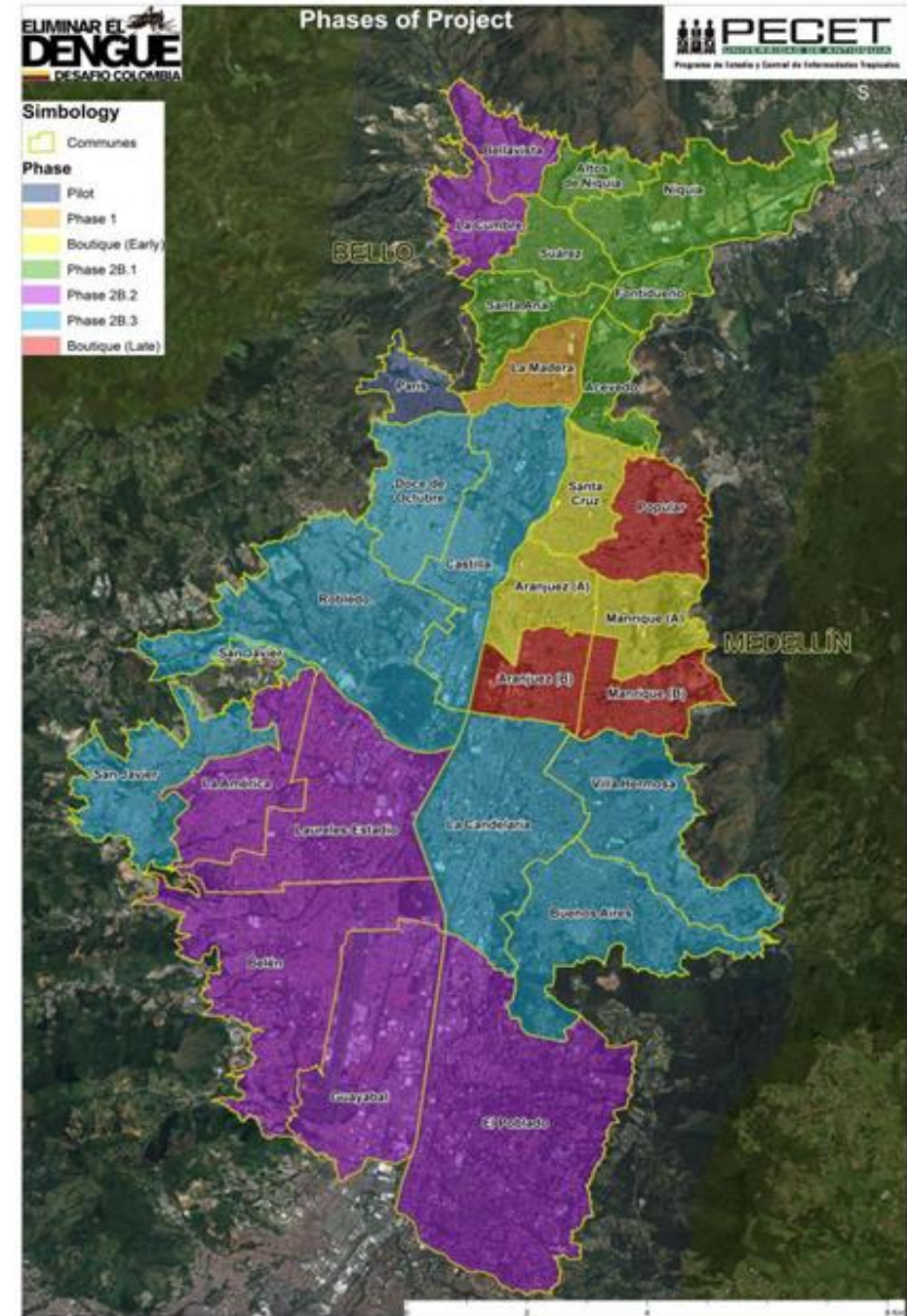
**Localización de trampas  
 BGs, GATs y OVTs**



# Efficacy Assessment

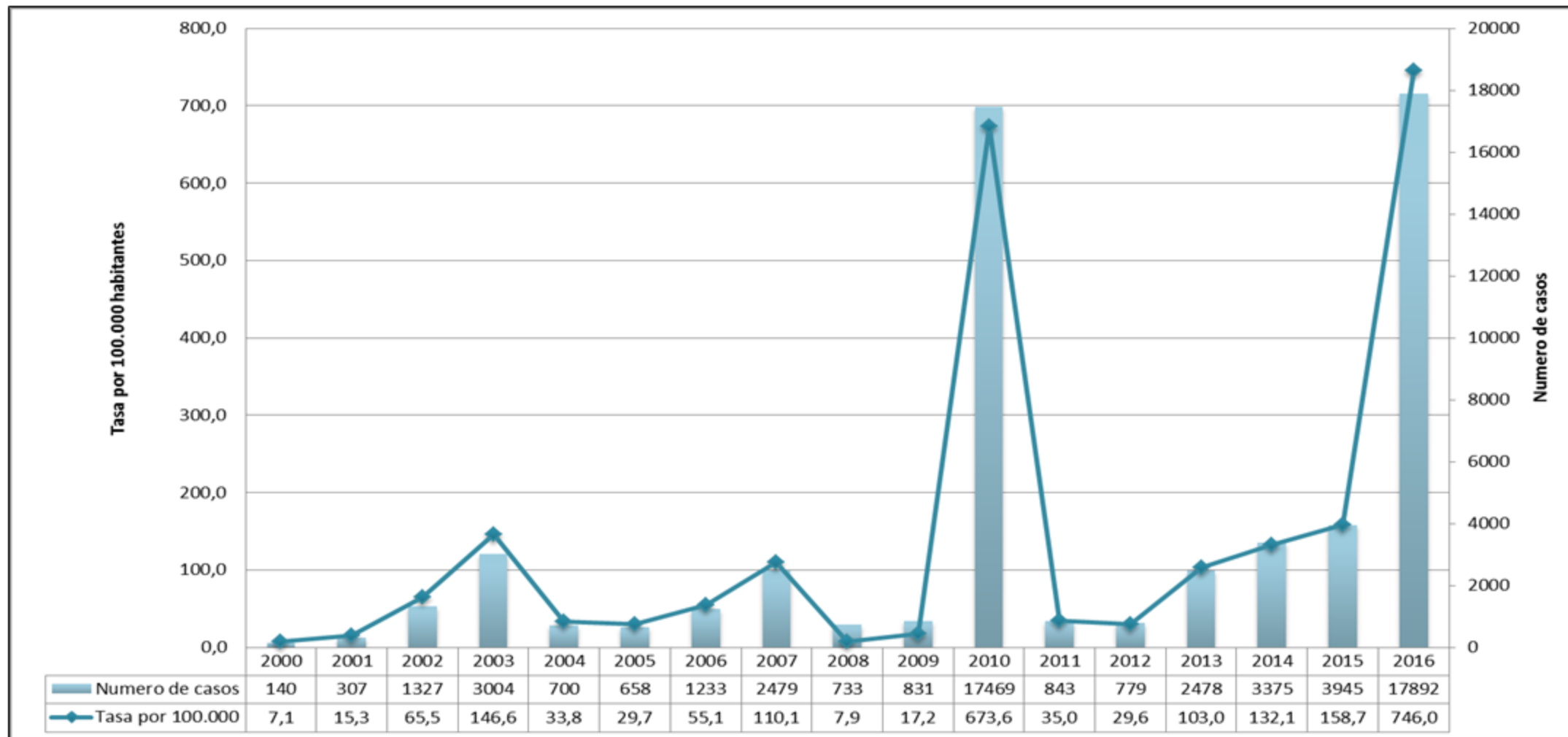
# Efficacy before and after

Casos medellin



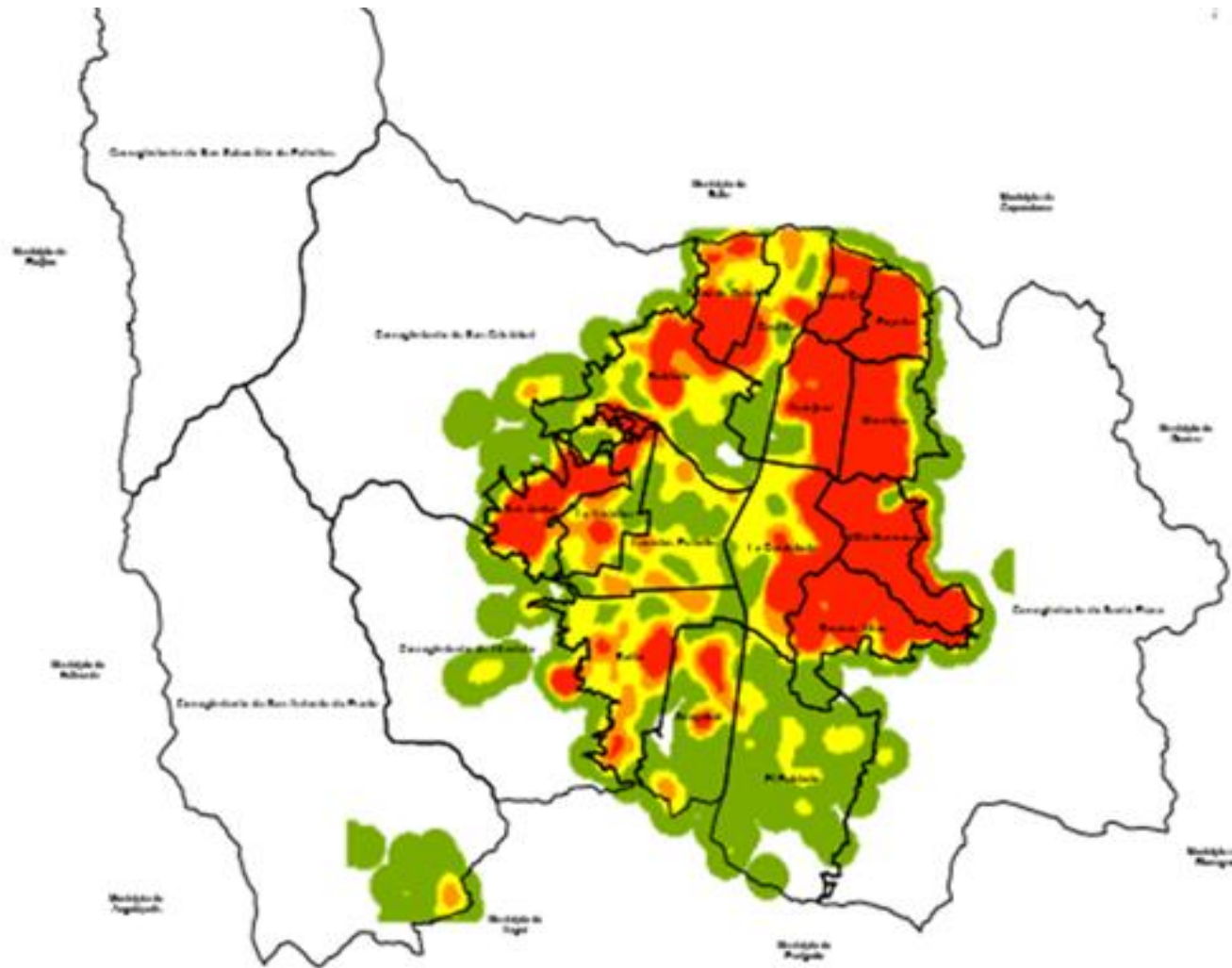
# Reporte de casos de dengue - Medellín

## 2000 a 2016

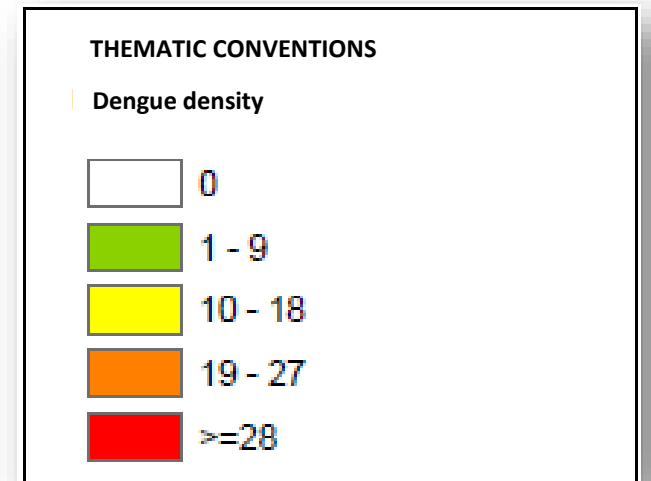




# Density of dengue cases per km<sup>2</sup>, 2016

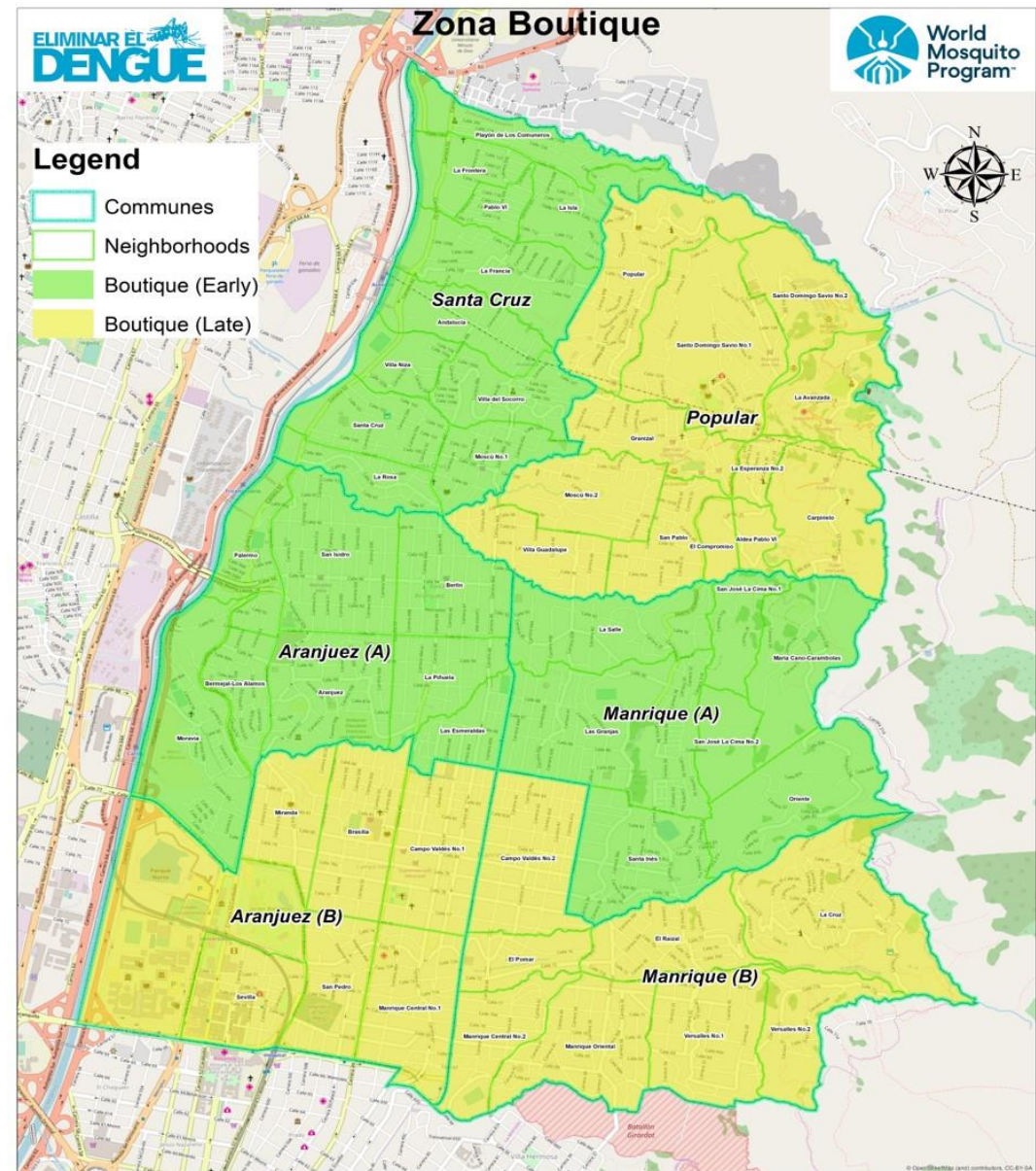


## Accumulated cases



# Boutique Area

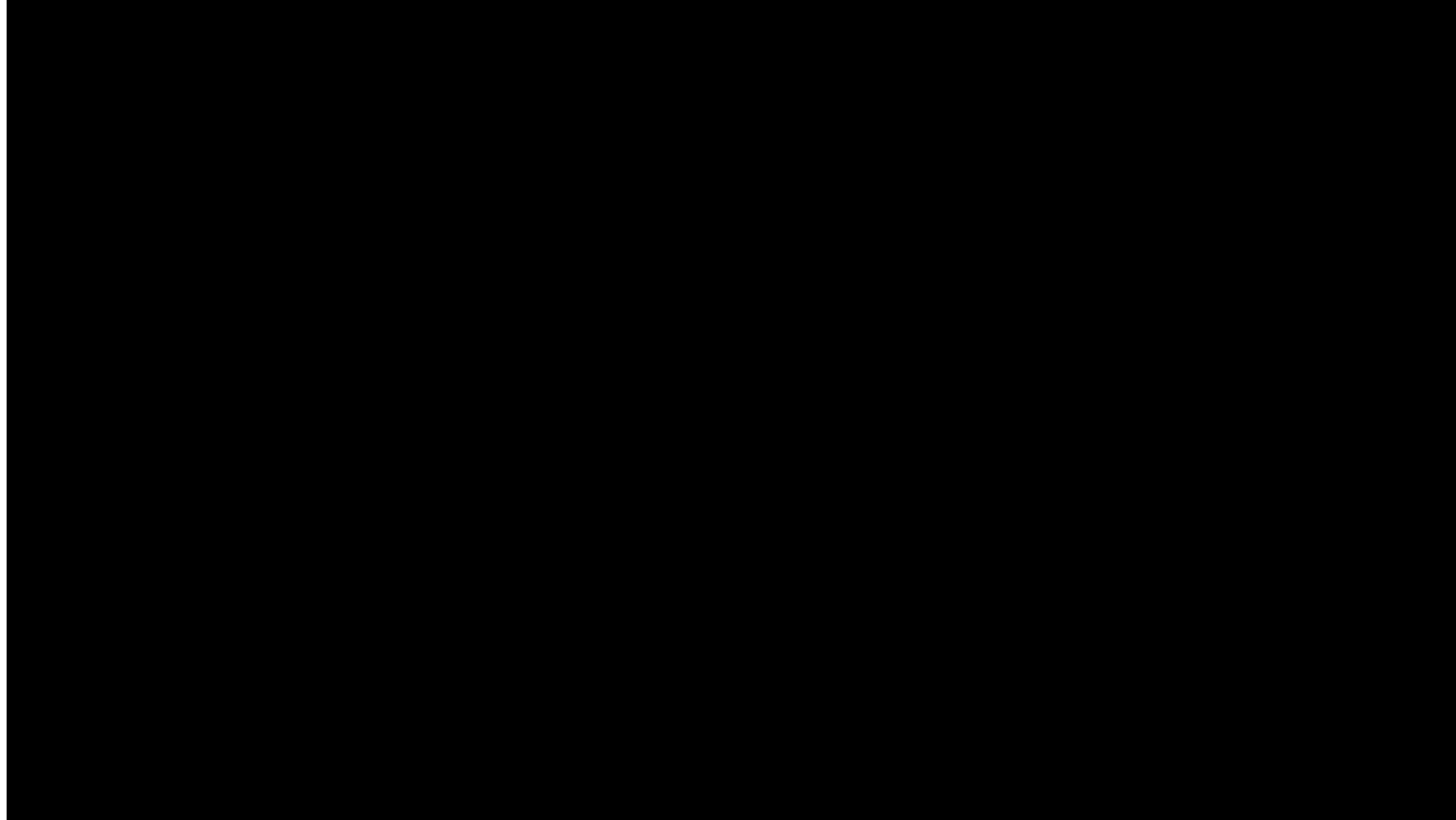
Incidence in areas with W+  
VS  
areas without W+



# NATIONAL INDEPENDENT EVALUATION GROUP



# Liberaciones de mosquitos con *Wolbachia*?



# Así monitoreamos/Red de Padrinos Video



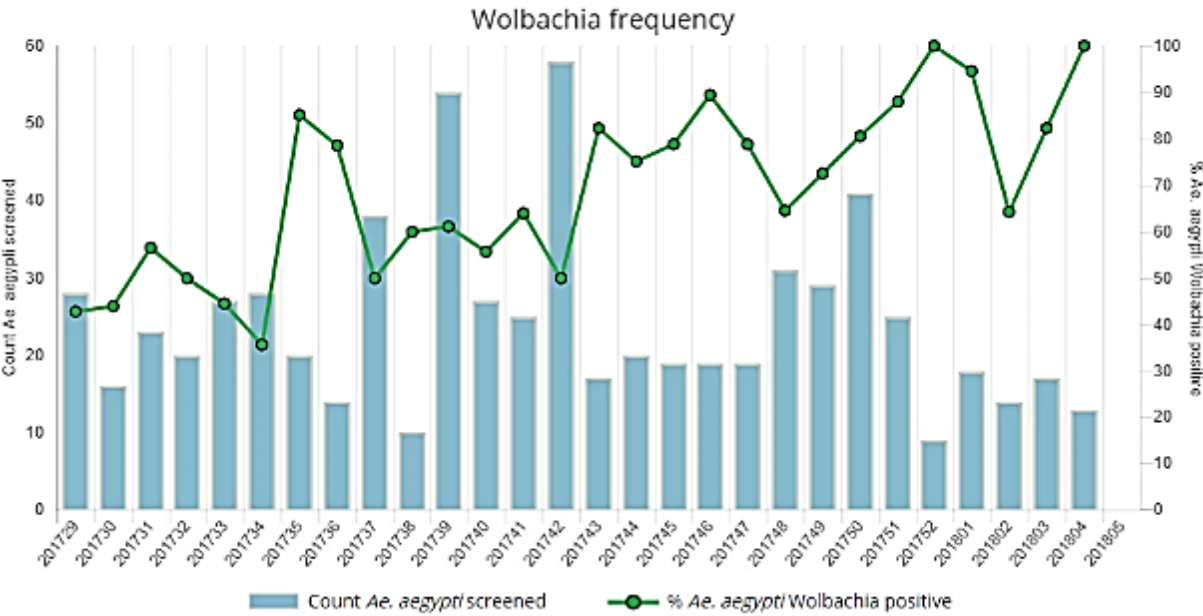
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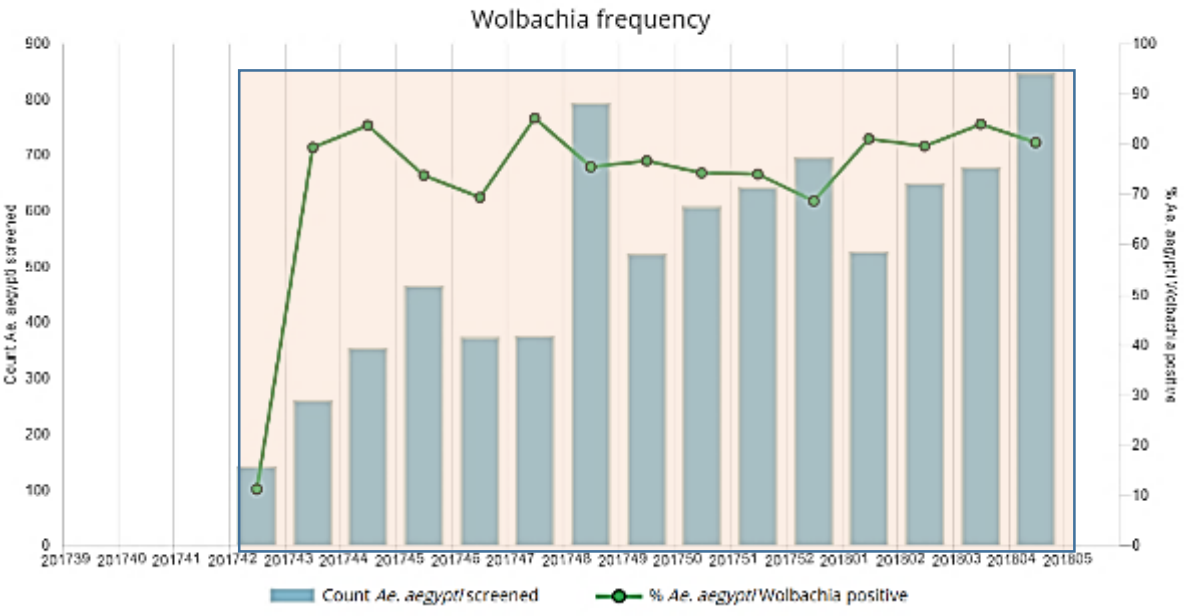
# Releases in Paris and Poblado and wMel infection

## Paris



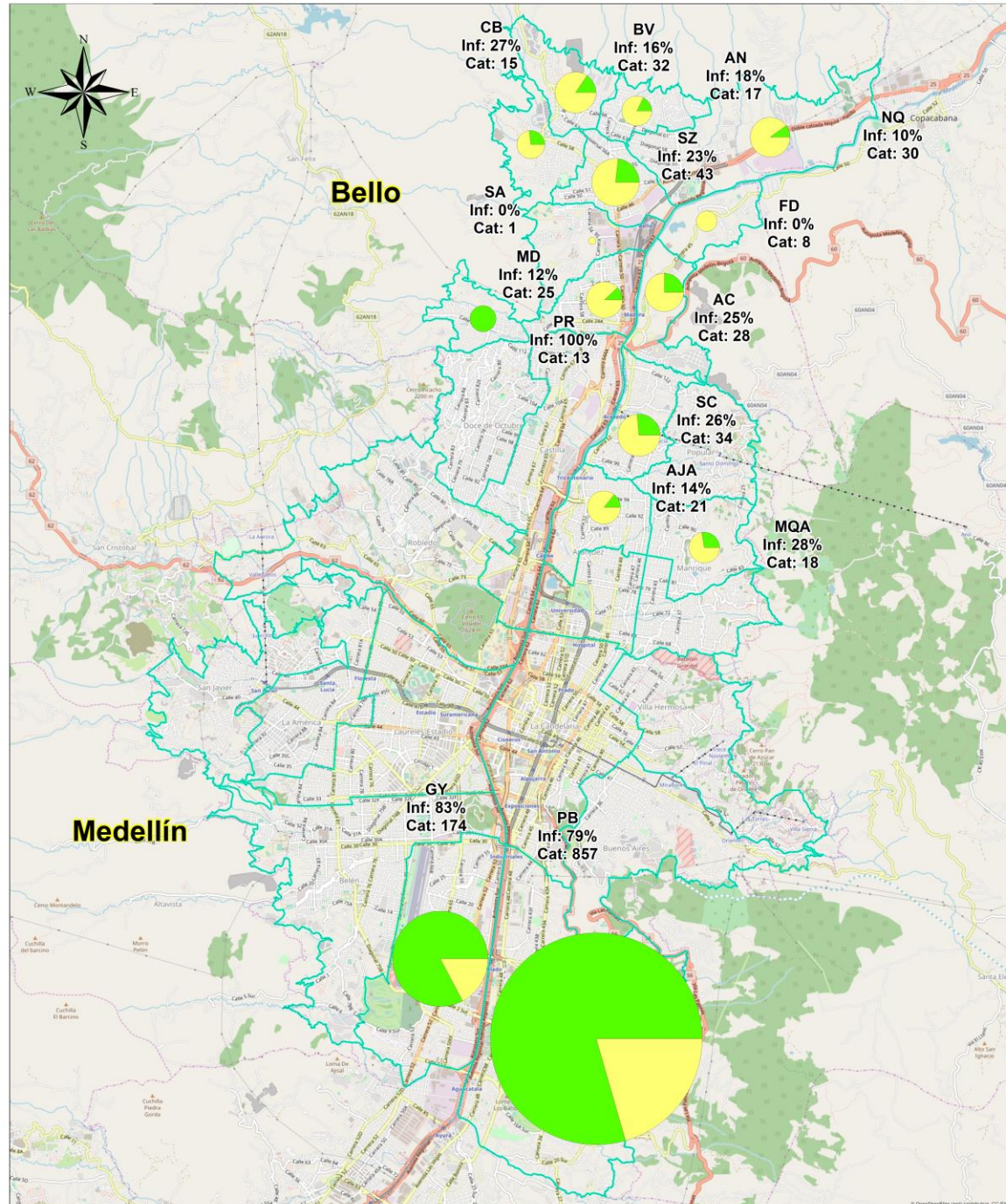
- Releases from May 27<sup>th</sup> to Dic 17<sup>th</sup> 2015
- 21 release weeks

## El Poblado

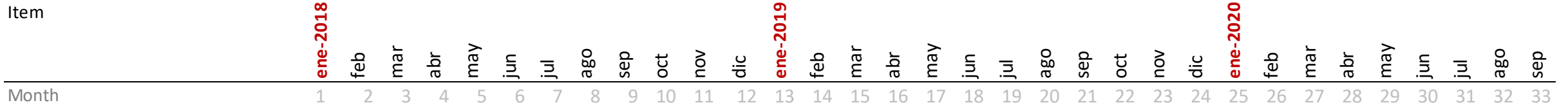


- Releases from Oct 19<sup>th</sup>, 2017 to Jan 4<sup>th</sup> 2018





# Planning 2018-2020

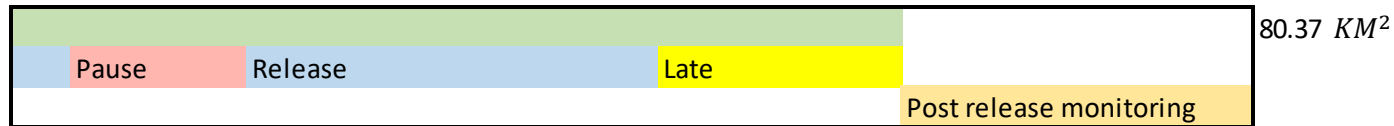


## Overall High level timeline



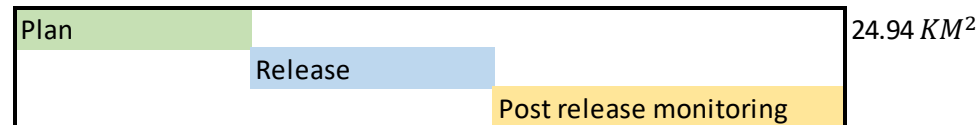
## Current plan for Medellin and Bello

- Comms & CE
- Releases
- Post release monitoring



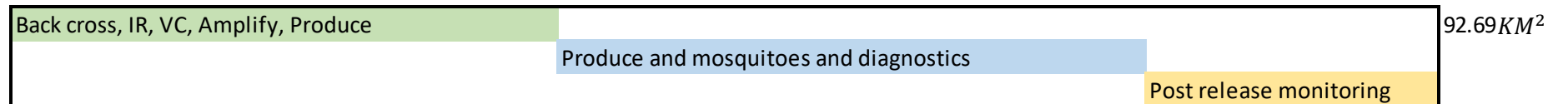
## Plan for Aburra Valley

- Planning, IR, Comms & CE
- Releases
- Post release monitoring



## Support for Cali

- Mosquito line, IR, VC
- Releases
- Post release monitoring



## The Burden of Dengue and the Financial Cost to Colombia, 2010–2012

Raúl Castro Rodríguez,\* Gabriel Carrasquilla, Alexandra Porras, Katia Galera-Gelvez,  
Juan Guillermo Lopez Yescas, and Jorge A. Rueda-Gallardo

*Department of Economics, Universidad de los Andes, Bogotá, Colombia; Centro de Estudios e Investigación en Salud (CEIS),  
Fundación Santa Fe de Bogotá, Bogotá, Colombia; Fundación Santa Fe de Bogotá, Universidad El Bosque, Bogotá, Colombia;  
Sanofi Pasteur Latin America, Mexico City, Mexico*

**Abstract.** Data on the burden of dengue and its economic costs can help guide health policy decisions. However, little reliable information is available for Colombia. We therefore calculated the burden of the disease, expressed in disability-adjusted life years (DALYs), for two scenarios: endemic years (average number of cases in non-epidemic years 2011 and 2012) and an epidemic year (2010, when the highest number of dengue cases was reported in the study period). We also estimated the total economic cost of the disease (U.S. dollars at the average exchange rate for 2012), including indirect costs to households derived from expenses such as preventing entry of mosquitos into the home and costs to government arising from direct, indirect, and prevention and monitoring activities, as well as the direct medical and non-medical costs. In the epidemic year 2010, 1,198.73 DALYs were lost per million inhabitants versus 83.88 in endemic years. The total financial cost of the disease in Colombia from a societal perspective was US\$167.8 million for 2010, US\$129.9 million for 2011, and US\$131.7 million for 2012. The cost of mosquito prevention borne by households was a major cost driver (accounting for 46% of the overall cost in 2010, 62% in 2011, and 64% in 2012).



COMUNICACIÓN BREVE

## Presencia de *Aedes (Stegomyia) aegypti* (Linnaeus, 1762) y su infección natural con el virus del dengue en alturas no registradas para Colombia

Freddy Ruiz-López<sup>1</sup>, Ana González-Mazo<sup>1</sup>, Andrés Vélez-Mira<sup>1</sup>, Giovan F. Gómez<sup>1</sup>,  
Luisa Zuleta<sup>1,2</sup>, Sandra Uribe<sup>1,2</sup>, Iván Darío Vélez-Bernal<sup>1</sup>

<sup>1</sup> Programa de Estudio y Control de Enfermedades Tropicales, PECET, Universidad de Antioquia, Medellín, Colombia

<sup>2</sup> Grupo de Investigación en Sistemática Molecular, Universidad Nacional de Colombia, Medellín, Colombia

**Introducción.** *Aedes aegypti* es el principal vector de fiebre amarilla urbana, dengue, chikungunya y zika. Se ha demostrado que la distribución biogeográfica de esta especie se ha expandido debido al calentamiento global y a factores socioeconómicos y culturales. Los cambios en los patrones de la distribución altitudinal de este vector y su infección con el virus son prioridades de la investigación encaminada a desarrollar estrategias de vigilancia entomológica y virológica en salud pública.

**Objetivo.** Evaluar la presencia de *A. aegypti* y su infección natural por el virus del dengue en alturas superiores a los 1.800 msnm en dos municipios periféricos del Valle de Aburrá, Antioquia, Colombia.

**Materiales y métodos.** Se instalaron 21 ovitrampas en los municipios de Bello y San Pedro de los Milagros, en un rango altitudinal de 1.882 a 2.659 msnm. Los adultos que emergieron de las ovitrampas se evaluaron con reacción en cadena de la polimerasa en tiempo real (RT-PCR) para la detección del virus del dengue.

**Resultados.** Se recolectaron 367 adultos de *A. aegypti*, siete de los cuales se encontraron a una altitud de 2.302 msnm en Tierradentro, Bello. Se detectaron 12 especímenes de *A. aegypti* positivos para dengue serotipo 2 en el barrio París de Bello, a 1.984 msnm.

**Conclusión.** Por primera vez se registró *A. aegypti* a 2.302 msnm, la mayor altitud registrada para este vector en Colombia. De igual forma, se encontró infección con el virus del dengue a 1.984 msnm. Estos hallazgos son significativos, ya que determinan regiones de Colombia con riesgo potencial de transmisión autóctona de dengue y otros arbovirus por *A. aegypti*.

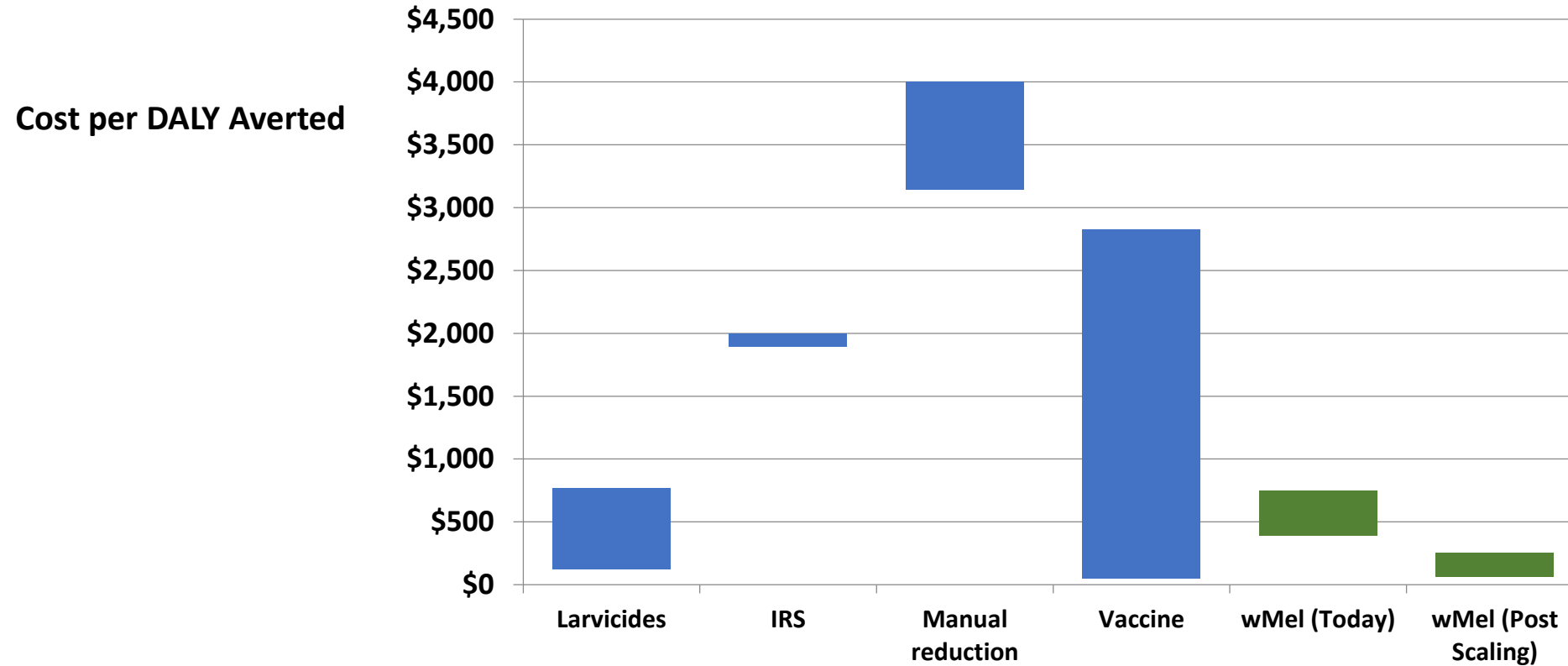
**Palabras clave:** *Aedes aegypti*, altitud, ubicaciones geográficas, dengue, Colombia.

doi: <http://dx.doi.org/10.7705/biomedica.v36i2.3301>



© CINHP, J. G. McCormick

## wMel es una intervención bastante costo efectiva



Sources: Larvicides estimate from Suaya et al (2007)

Indoor Residual Spraying(IRS) from BCG analysis 2011

Vaccine dose prices ranging from \$.50 to \$5 with 85% coverage and 80% effectiveness drug cost only

wMel (Today) \$7-10/person cost applied to dengue endemic countries covering 60%-80% of population

wMel (Post Scaling) based on expected \$1-3/person deployment cost deployed in 60%-80% of population

# 12 PAISES

- AUSTRALIA
- INDONESIA
- VIETNAM
- BRASIL
- COLOMBIA
- INDIA
- SRI LANKA
- KIRIBATI
- VANUATO
- FIJI
- NUEVA CALEDONIA
- MEXICO



# Nuestra alternativa

World Mosquito Program es una iniciativa **sin fines de lucro** que trabaja para **proteger** a la comunidad mundial de las enfermedades transmitidas por mosquitos.

Utiliza un método **seguro, natural y autosostenible** para reducir el riesgo de enfermedades transmitidas por mosquitos como el Zika, el dengue y el chikungunya.

- ✓ Amigable con el medio ambiente
- ✓ Medida de control más económica que existe
- ✓ Autosostenible
- ✓. Previene urbanización Fiebre Amarilla

• **GRACIAS**



**World  
Mosquito  
Program™**



**UNIVERSIDAD  
DE ANTIOQUIA**

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# Fumigations with Malathion in Boutique and wMel infection

