



THE UNIVERSITY OF ARIZONA

Agriculture, Life &  
Veterinary Sciences &  
Cooperative Extension



# Zika Preparedness and Response

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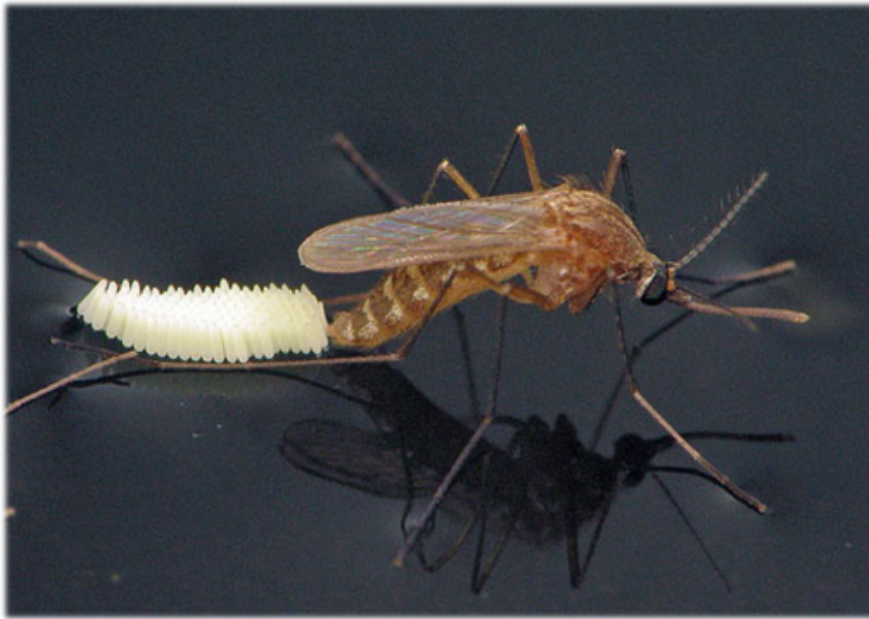
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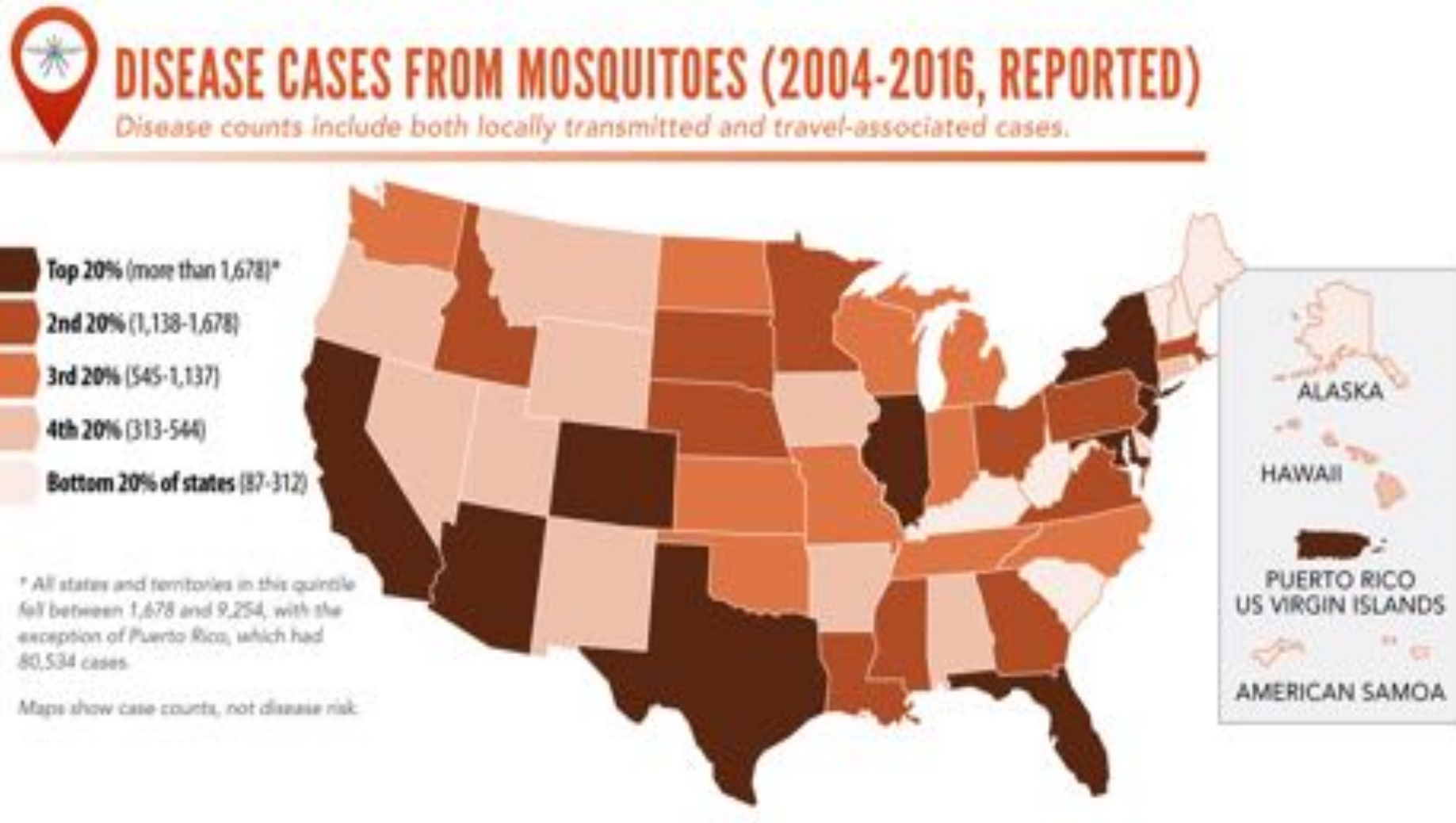




*Culex* mosquitoes

*Aedes* mosquitoes

# Increased risk for human disease



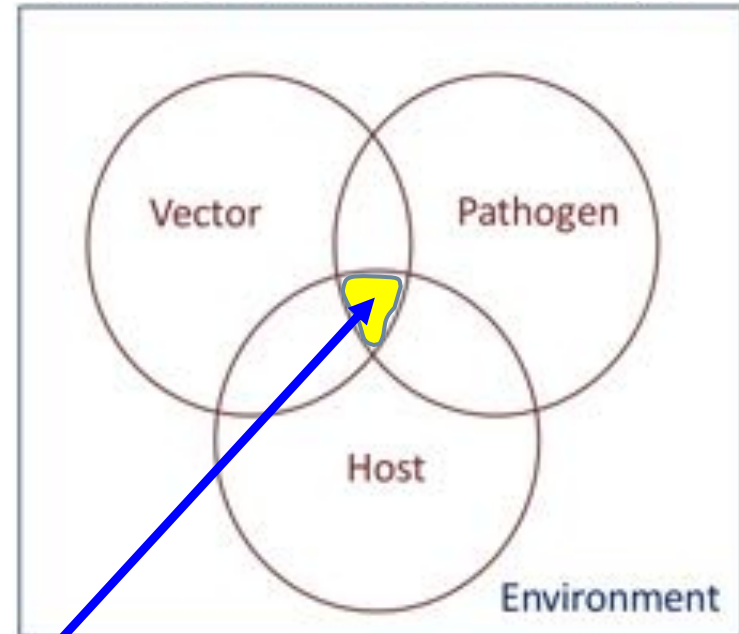
Vital Signs: Trends in Reported Vectorborne Disease Cases — United States and Territories, 2004–2016, <https://www.cdc.gov/mmwr/volumes/67/wr/pdfs/mm6717e1-H.pdf>



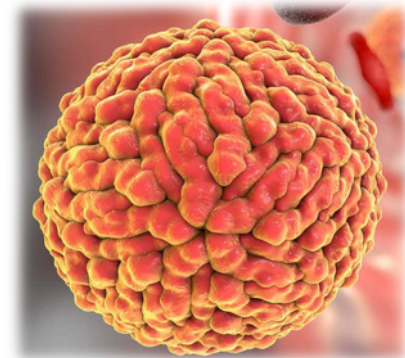
# Vector-borne diseases

- Three components:

- ▣ **Pathogen**, e.g. viruses, bacteria, and protozoa
- ▣ **Vector** - blood feeding arthropods capable of transmitting pathogens between hosts, e.g. mosquitoes, ticks and fleas
- ▣ **Host**



A pathogen, a competent vector, and a susceptible host exist in one physical location at the same time with a supportive environment



# Mosquitoes as vectors

- **Vectors** are living organisms that can transmit disease-causing pathogens (e.g. bacteria, viruses, or parasites) between humans, or from animals to humans.
- **ARBOVIRUS = Arthropod-borne Virus**
- Can include viruses carried by mosquitoes or other arthropods

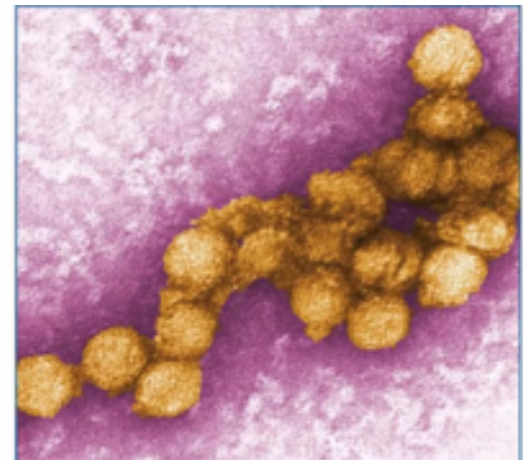
CDC



# Mosquito-vectored viruses

6

- **Culex** mosquitoes - West Nile, St. Louis encephalitis, Western/Eastern equine encephalitis, Powassan, California Serogroup viruses
- **Aedes** mosquitoes - Dengue, chikungunya, Zika viruses



# Zika virus basics

7

- Zika virus is transmitted to people primarily through the bite of an infected *Aedes* mosquito
- Zika virus can also be transmitted from mother to child, through blood transfusions, and through sexual contact
- Zika infection during pregnancy can cause certain birth defects (microcephaly – a baby's head is smaller than expected)
- No vaccine or medicine for Zika

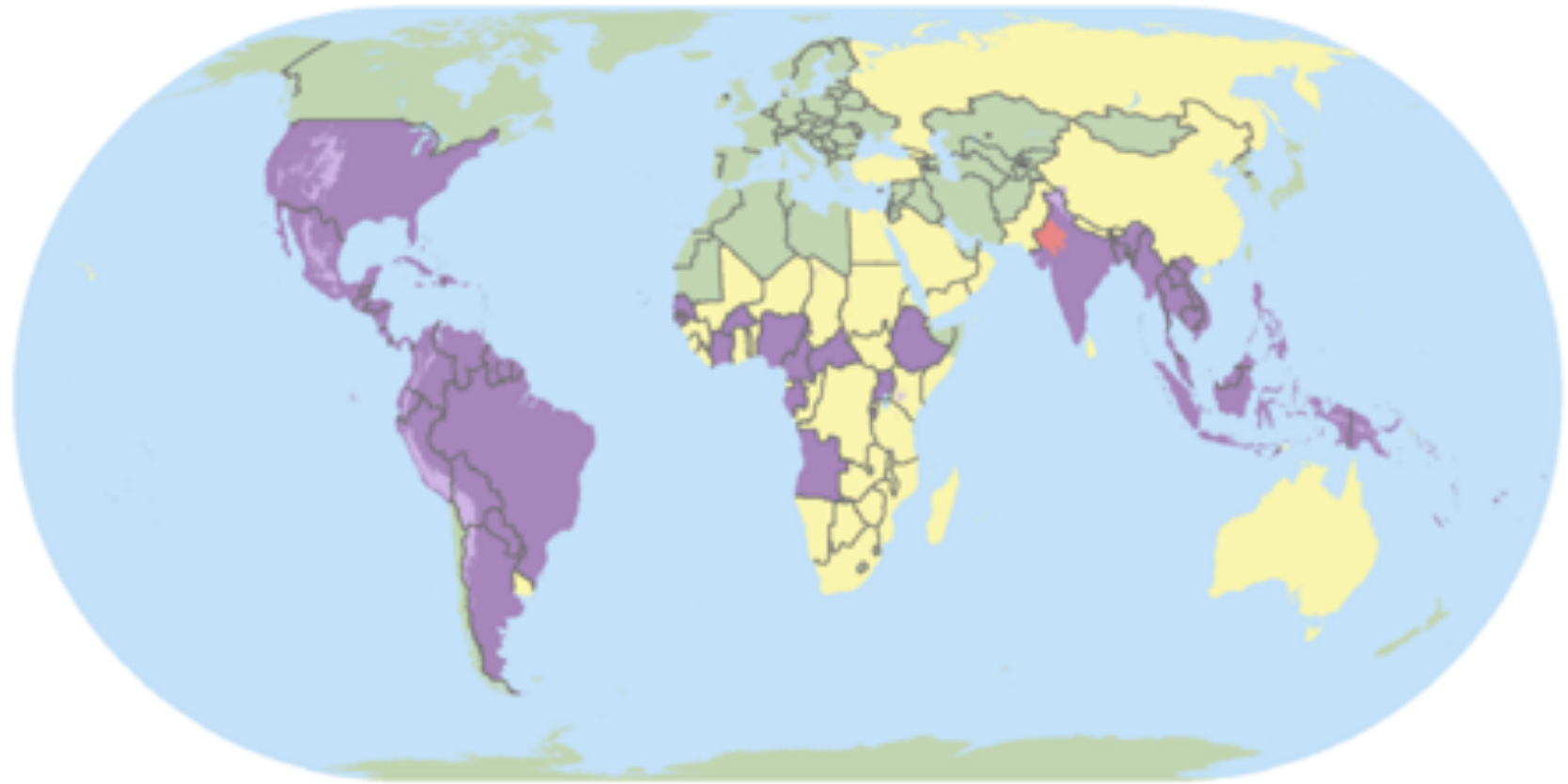
# Zika virus basics

8

- First discovered in 1947
- Began fast spreading until 2015
- By 2016, the WHO declared the outbreak a public health emergency
- By 2017, hundreds of thousands of people had been infected throughout South and Central America, as well as in parts of Africa and Asia



# World map of areas with risk of Zika



## Map Legend

- |  |   |
|--|---|
|  Area with current Zika outbreak   |  Country with mosquito* but no reported Zika cases**      |
|  Country or territory that has ever reported Zika cases** (past or current)                            |  Country or territory with no mosquitoes that spread Zika |
|  Areas with low likelihood of Zika infection because of high elevation (above 6,500 feet/2,000 meters) | * <i>Aedes aegypti</i>  |
|  | ** Locally acquired, mosquito-borne Zika cases  |

# History of Zika virus in the US

10

- Prior to 2014, very few travel-associated cases of Zika virus disease were identified in the US.
- In 2015 and 2016, large outbreaks of Zika virus occurred in the Americas. Zika virus disease became a nationally notifiable condition.
- **Florida and Texas reported local transmission of Zika virus by mosquitoes in 2016-17.**

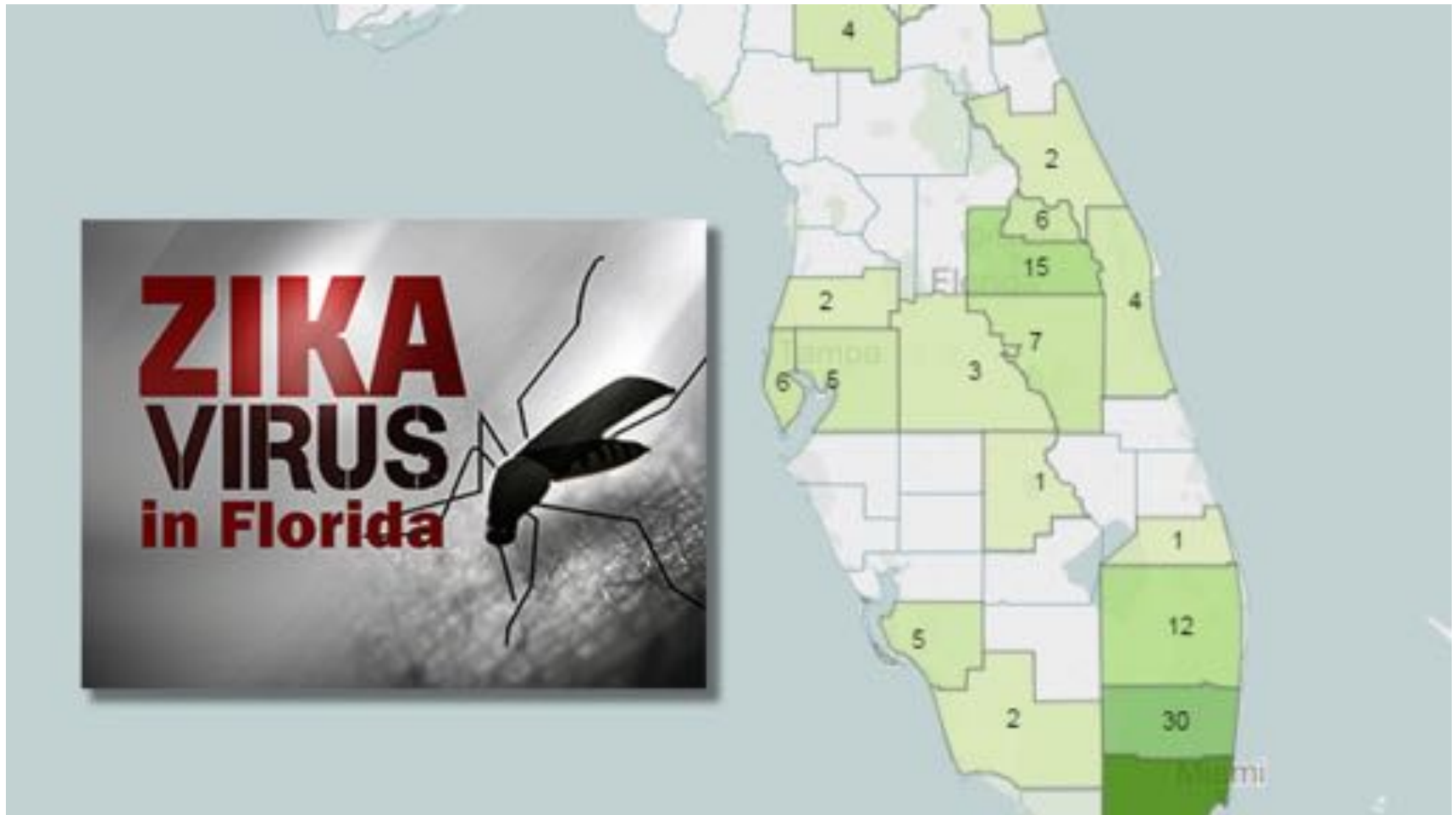
# History of Zika virus in the US

11

- In 2017, the number of reported Zika virus disease cases in the United States started to decline.
- In 2018 and 2019, there have been no reports of Zika virus transmission by mosquitoes in the continental United States.
- In 2019, there have been no confirmed Zika virus disease cases reported from United States territories.
- There is no current local transmission of Zika virus in the continental United States.

# Zika Virus Outbreaks in Florida

12



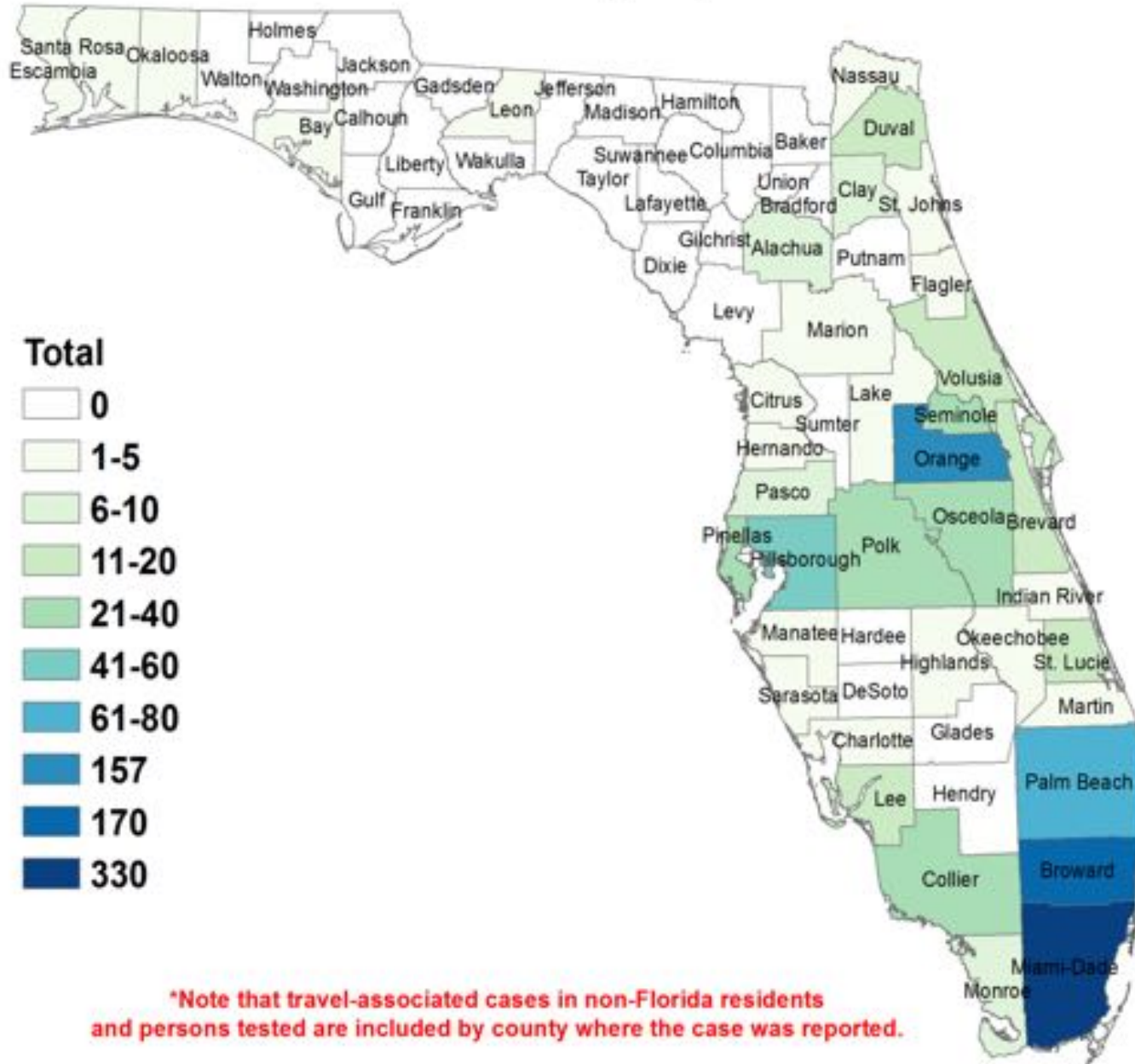
# Situation: Florida risk assessment

13

- ❑ Large number of travelers coming from Zika impacted areas
- ❑ Mosquitoes present year-round
- ❑ Different levels of control capability across the state
- ❑ Florida remained a high-risk for local transmission of Zika

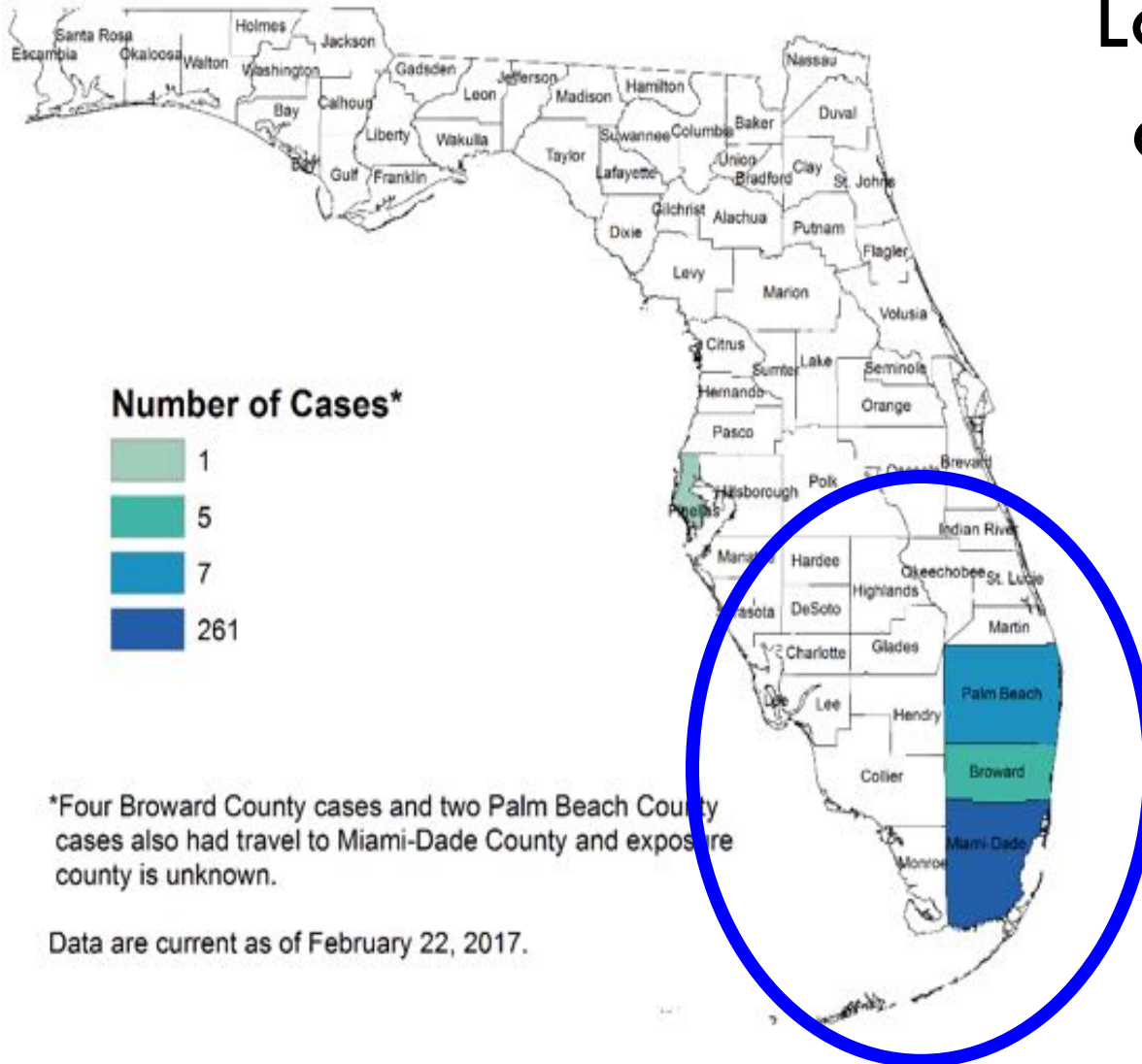


# Travel-Associated Zika Fever Cases as of February 21, 2017



Zika  
Response  
to  
Primarily  
Travel-  
Related  
Infections

## Florida Counties Reporting Zika Virus Introductions, 2016



In 2016 & 2017,  
Locally acquired  
cases of Zika in  
Florida

Counties  
with  
Locally-  
Acquired  
Infections



# What is local transmission?

17

A person who has not traveled recently gets bitten by an infected mosquito where they live, work or play.



A mosquito bites a person who is sick. The mosquito gets infected.

Infected mosquitoes can then bite healthy people and spread the infection.

Within 3–7 days, the person may become sick. Other mosquitoes can bite the sick person, become infected, and bite more people.



# What had been done?

18

- ❑ Formed the Florida Zika Incident Management Team
- ❑ Enhanced mosquito surveillance & mosquito control response in coordination with epi information
- ❑ Enhanced disease surveillance & prevention efforts





# What had been done?

19

- Enhanced laboratory testing
- Enhanced communication with the public and between partners
- Extensive statewide or regional trainings to a wide variety of stakeholders



Photos courtesy of Miami Herald

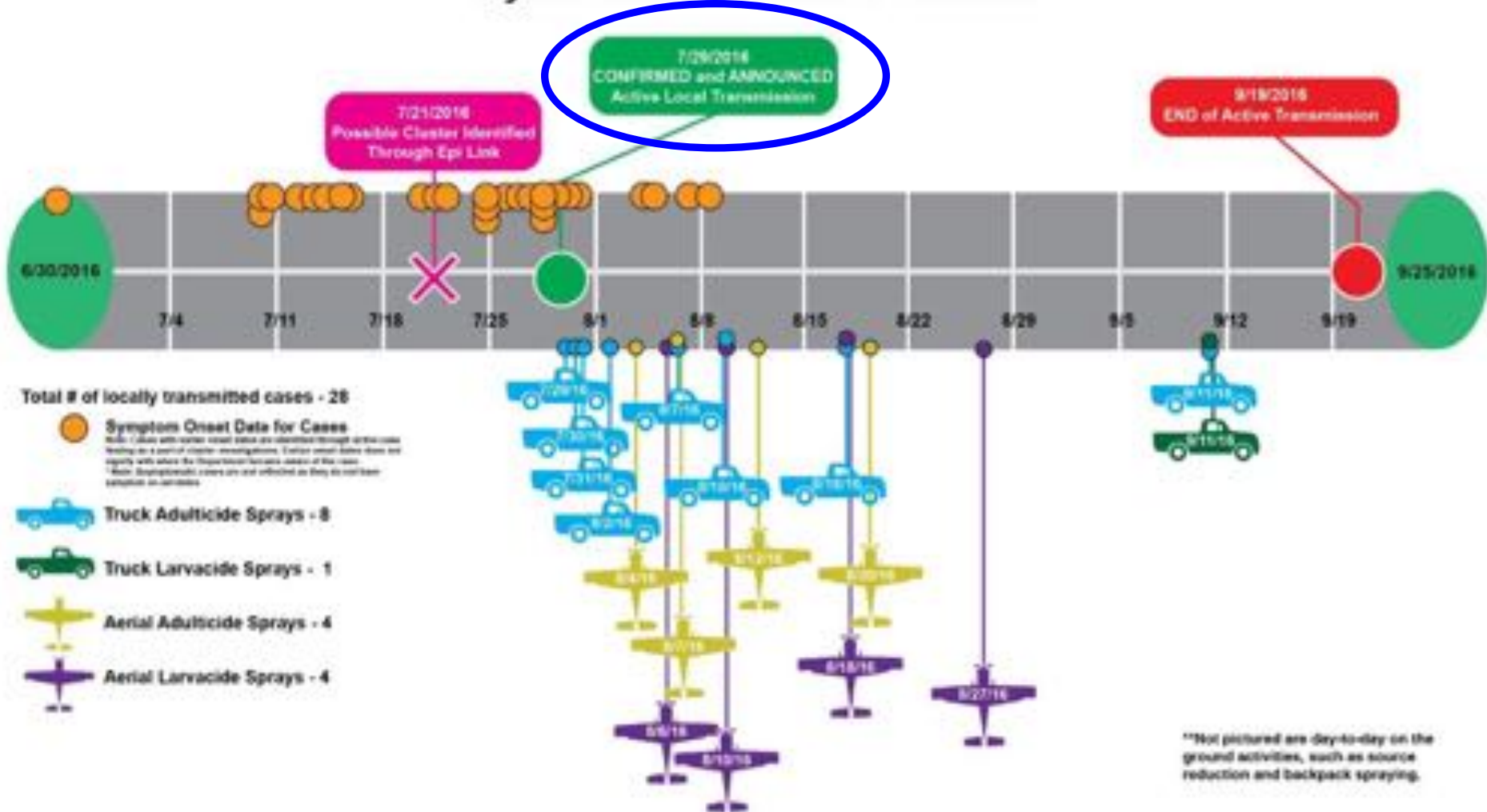
# Field investigation in Miami

20



Photos courtesy of DOH in Miami-Dade and Palm Beach Counties

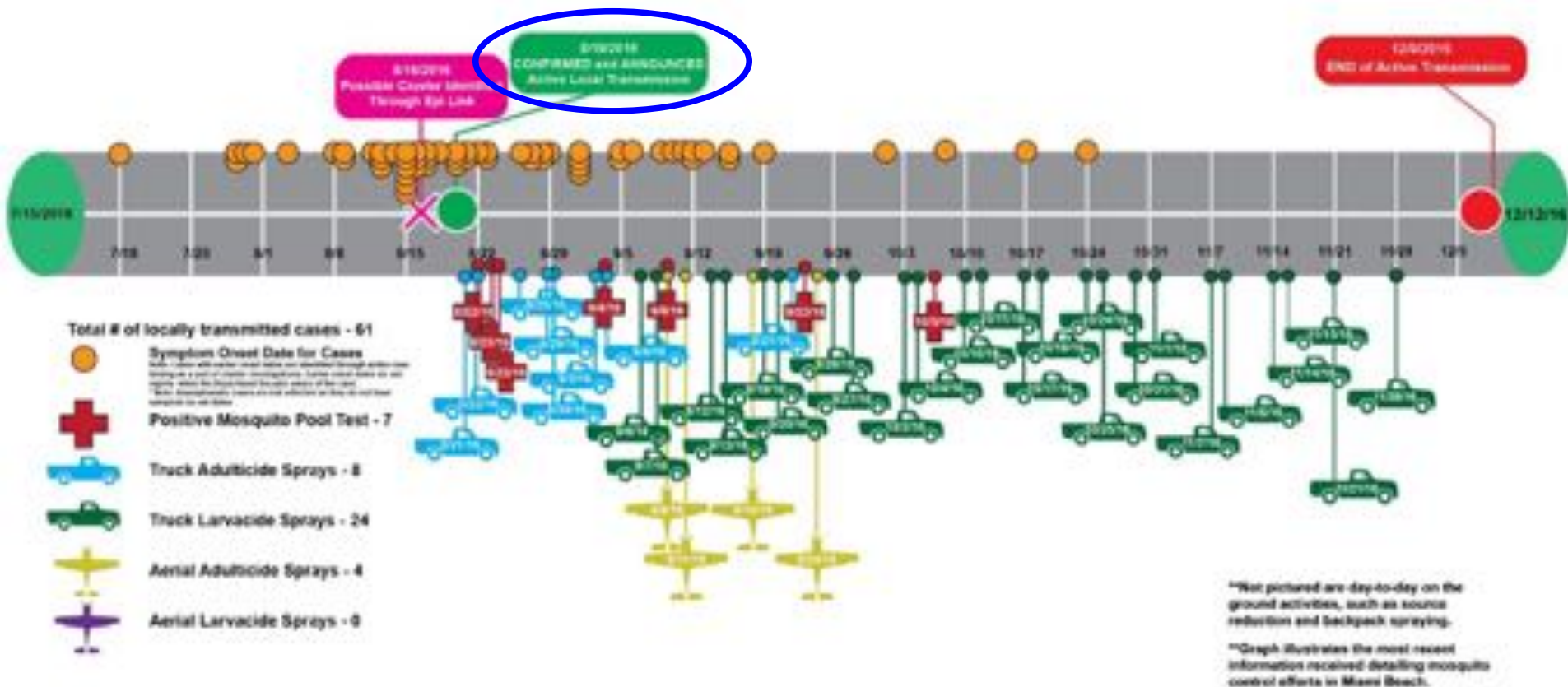
## Wynwood Zika Activities Timeline



Wynwood Neighborhood locally-acquired Zika infections

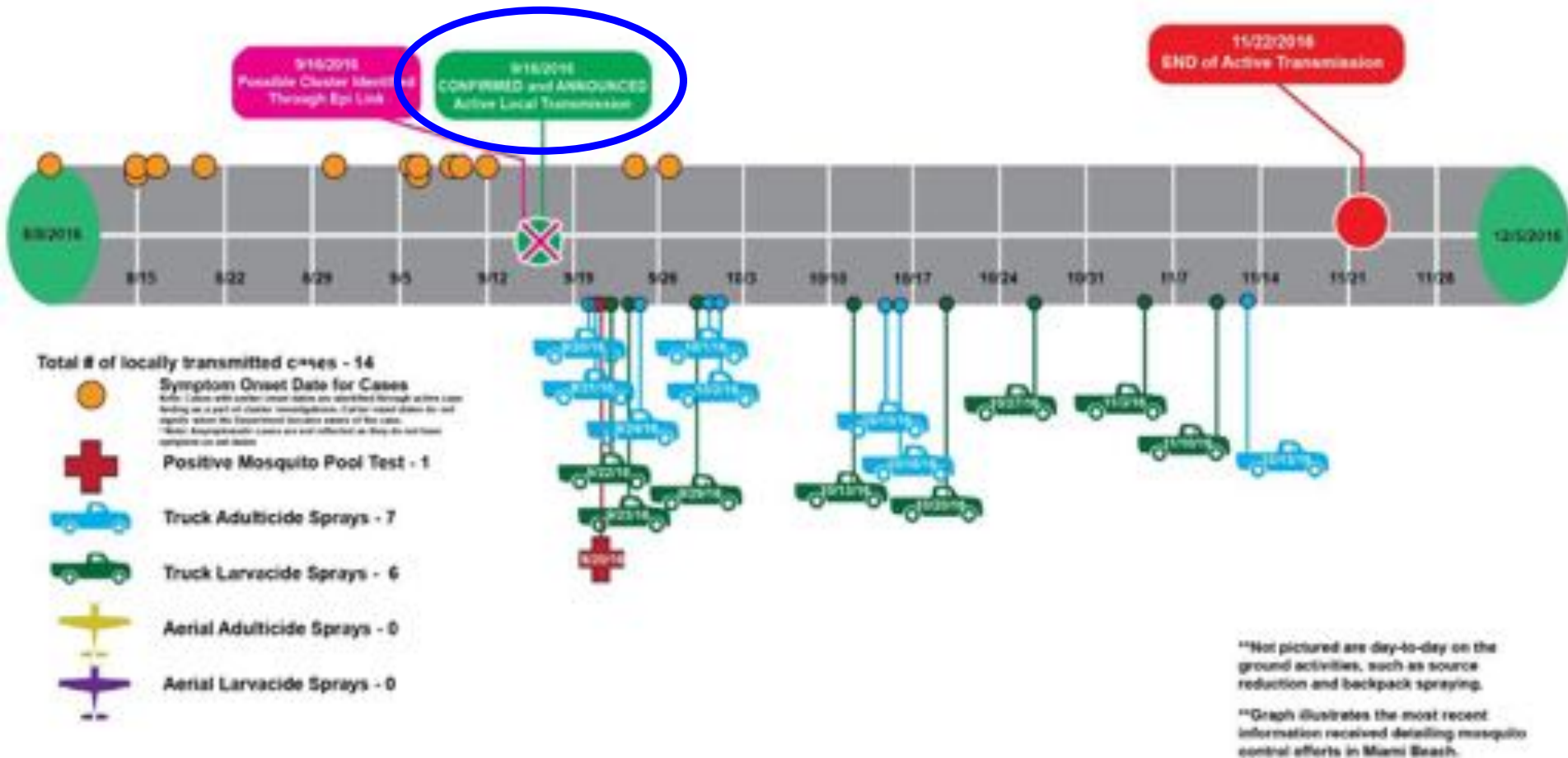


## South Miami Beach Zika Activities Timeline



South Miami Beach locally-acquired Zika infections

## North Miami Beach Zika Activities Timeline



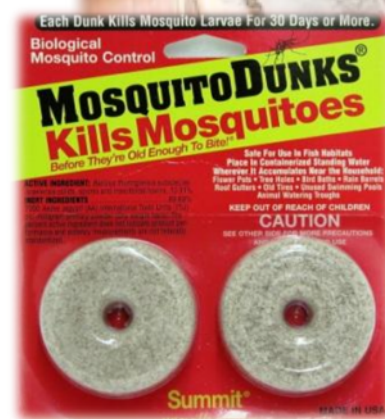
North Miami Beach locally-acquired Zika infections



# Types of Larvicides

- Oils
  - Suffocation – mechanical barrier at surface
  - Suffocation – oil entering the siphon blocking the passage of air
  - Poisoning due to toxic properties of the volatiles
- Monomolecular films
  - Floods the tracheal tubes with water
  - Breaks surface tension
- Bacteria (Bti\*, *B. sphaericus*, spinosad)
- Insect growth regulators (growth hormones) (e.g. pyriproxyfen, methoprene)

Bti\* = *Bacillus thuringiensis israelensis*





Several types of formulations  
and applications

Mixed formulation of  
an adulticide and  
larvicide

# Methods of Adulticiding

- Space spraying
  - Aerial-based adulticiding (plane, helicopter, etc.)
  - Ground-based adulticiding (truck)
  - Backpack or hand fogger
- Barrier residual spraying
  - Residual insecticides on external resting sites (walls, vegetation)
- Indoor residual spraying (IRS)
  - Residual insecticides on internal resting sites (walls, ceilings, containers, curtain etc.)
  - Common internationally for mosquito resting indoors





# Lessons learned

27

- Plan ahead
- Involve others
- Inform the public
- Use the best science and data
- Have a response plan for a Mosquito-Borne Epidemic Emergency



# Zika Preparedness and Response

28

- Phase 0 – Preparation (vector present or possible in the jurisdiction)
- Phase 1 – Mosquito Season (Introduced travel cases, *Aedes* biting activity)
- Phase 2 – Confirmed Local Transmission (Single, locally acquired case, or cases clustered in a single household)

**Prevent - Detect - Respond**



# Essential Elements of Information

29

- Form the Zika Incident Management Team
  - ▣ Appoint a senior representative to coordinate Zika response efforts (0)
  - ▣ Pre-identify an incident manager and response team members (0)
  - ▣ Activate and define roles and responsibilities for local response/incident command team (0,1,2)
  - ▣ In collaboration with other agencies (0,1,2)

# Essential Elements of Information

30

## □ Epidemiological Information

- ▣ Surveillance plan for travel cases and sexual transmission from travel cases (0)
- ▣ Coordination plan between vector control and human surveillance (0)
- ▣ Protocols for collection and reporting of data (0)

# Essential Elements of Information

31

## □ Epidemiological Information

- ▣ Rapidly follow up suspected cases and take actions to avoid local transmission (1)
- ▣ Encourage reporting cases (1,2)
- ▣ Intensify surveillance for human cases and recommend actions to reduce mosquito bites (2)
- ▣ Enhance local surveillance for human cases (2)
- ▣ Determine the local transmission case status (2)

# Essential Elements of Information

32

## □ Laboratory Information

- Coordination plan for sample eligibility, referral, and testing (0)
- Establish point of contact for healthcare providers who have questions about testing (0)
- Communicate with providers about eligibility, process, specimen collection and submission, and notifications (0)

# Essential Elements of Information

33

## □ Laboratory Information

- Be aware of capacity of state lab and private lab partners (1,2)
- Be aware of current guidance on specimen collection, transportation, and reporting of results (1,2)
- Rapid procedures and confirmatory testing of suspected cases (1,2)



# Essential Elements of Information

34

- Mosquito (Vector) Control Information
  - ▣ Protocol for rapid relay of positive cases to relevant mosquito control unit, and of mosquito control unit trapping activity to public health (0)
  - ▣ Protocol for habitat/breeding reduction activity (0)
  - ▣ Catalog vector control resources in jurisdiction (0)
  - ▣ Assess, revise, and report any changes to historic *Aedes* mapping and insecticide resistance data (0)

# Essential Elements of Information

35

- Mosquito (Vector) Control Information
  - ▣ Explore focused community interventions to disrupt breeding grounds (1,2)
  - ▣ Leverage partnerships with local governments and non-profits for support (1,2)
  - ▣ Intensify larval and adult mosquito control (2)
  - ▣ Ensure accurate information flow and smooth communication (2)

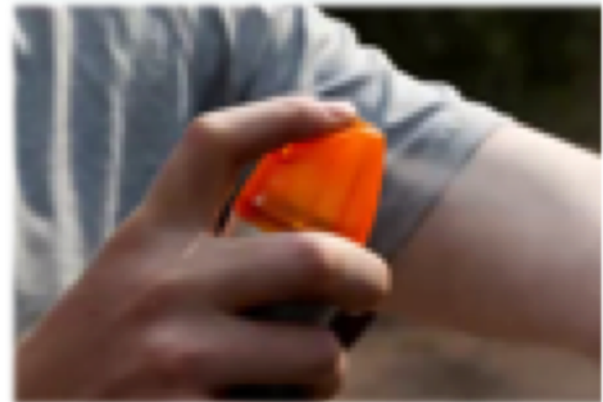
# Essential Elements of Information

36

- ❑ Community Outreach Information
  - ❑ Ensure training and educational materials have reached pregnant women (0)
  - ❑ Ensure accurate information flow (0)
  - ❑ Reduce mosquito exposure (0)
  - ❑ Deploy communication, surveillance, and monitoring programs for pregnant women (1,2)
  - ❑ Deploy the registry of Zika cases during pregnancy for monitoring and follow-up of birth outcomes (2)

# Integrated Mosquito Management

- Surveillance
- Source Reduction
  - Eliminate breeding sites and reducing hiding sites
- Biological Control
  - Fish, copepods, turtles
- Insecticides
  - Larvicides: oils, films, bacteria, IGR
  - Adulticides: barriers, traps
- Resistance Testing
- Public Education
  - Use repellents, eliminate containers, reduce conducive conditions



When possible, stay inside between dusk and dawn, when mosquitoes are most active.



Fix broken screens in windows and doors.



Empty and scrub, toss or cover items that can hold water to stop mosquitoes from breeding.



Wear clothing that covers your arms and legs.



Use EPA-registered insect repellent\* on exposed skin and clothes. Follow label instructions.

\*With one of the following active ingredients: DEET, picaridin, IR3535, oil of lemon eucalyptus, PMD, 2-undecanone.

[Nootkatone, a new active ingredient](#)



# Thank you!

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