THE ZIKA EPIDEMIC

IMPLICATIONS FOR SLC STATES

Thursday, June 9 | 2 p.m. EDT | FREE Webinar Presented by CSG South/SLC
CDC Responds to ZIKA

Zika and Mosquito 101

Updated June 6, 2016
How is Zika transmitted?

- Zika can be transmitted through:
  - Mosquito bites
  - From a pregnant woman to her fetus
  - Sexual contact
  - Blood transfusion
Zika Virus Transmission Cycles

**Sylvatic cycle**
- *Ae. (Stegomyia)*
- *Ae. (Diceromyia)*

**Epidemic (urban) cycle**
- *Ae. aegypti*
- *Ae. albopictus*
Estimated Range of *Aedes aegypti* and *Aedes albopictus* Mosquitoes in the United States

*Maps have been updated from a variety of sources. These maps represent CDC’s best estimate of the potential range of *Aedes aegypti* and *Aedes albopictus* in the United States. Map is not meant to represent risk for spread of disease.*
### Aedes aegypti/Ae. albopictus
- Mostly bite during the day, but can also bite at night
- *Ae. aegypti* prefers to feed on people
- *Ae. albopictus* will feed on people and animals
- Prefers to lay eggs in man made containers that may dry out completely
- BG Sentinel traps and ovicups for surveillance

### Culex pipiens/Cx. quinquefasciatus
- Night biter
- Prefers birds
- Lays eggs in standing water with a lot of organic material (lakes, ditches, gutters, neglected pools)
- CDC gravid and light traps for surveillance
Aedes aegypti and Aedes albopictus
Container Aquatic Habitats for Zika Vectors

- Water-storage containers (barrels, jars, tanks, cisterns)
- Utensils (pails, tarps)
- Discarded containers (trash)
- Recreation objects (plastic pools, toys, boats)
- Ornamental (fountains, plant pots)
- Animal drinking pans
- Septic tanks
- Water meters
- Treeholes
**Aedes aegypti and Aedes albopictus Control**

*Focus at individual property level*

- Targeted outdoor residual spraying
- Targeted indoor residual spraying when appropriate
- Larvicide in containers, tires, tree holes
- Sanitation
- Widespread space spraying when required
What You Can Do During Mosquito Season

- Implement all mosquito control strategies, including:
  - Immature mosquito monitoring
  - Adult mosquito monitoring
  - Remove or dump water sources where larvae can grow
  - Use larvicides in water sources that cannot be removed or dumped
  - Conduct insecticide resistance testing
- Actively engage communities to perform source reduction
What You Can Do if Zika Cases Are Identified

- Mobilize comprehensive mosquito control strategies without delay to prevent local transmission
- Implement targeted vector control for adult and immature mosquitoes in and within 150 yards around an individual’s location
- Intensify larval control and source-reduction efforts
- Consider adding community-based adult mosquito control
  - Residual treatments
  - Space treatments
What You Can Do To Prepare

- Identify mosquito control assets in your state
- Identify where these mosquitoes are found
- Do you know what chemicals will be effective if spraying is needed?
- Are contingency contracts and intergovernmental agreements in place if needed?
- Make sure lines of communication are established between
  - Health Department
  - Mosquito Control
  - Emergency Preparedness
  - Other Relevant Agencies both State and local
- Make sure you have a communications plan for mosquito control activities
Communications – especially where no mosquito control is done

- Fact sheets, chemicals and processes
- Press releases
- Frequent questions
- Where will public be able to get answers
- Personal protection messaging
- Things the public can do themselves
www.cdc.gov/zika
Mosquito-borne disease: models of risk in urban landscapes

Shannon L. LaDeau
How do we define risk?
$R_0$ – the basic reproductive ratio
How many infections arise from one infected person?

Basic reproduction number ($R_0$)
The transmission rate for selected disease outbreaks

Ebola is not as contagious as many other diseases, but has a high fatality ratio.

Avian flu  
$R_0 = 0.7$

Plague  
$R_0 = 1.3$

Ebola  
$R_0 = 2$

Influenza  
$R_0 = 1$ to $3$

SARS  
$R_0 = 3$

Measles  
$R_0 = \text{approx. } 16$

$R_0$ (the basic reproduction number) is an approximate measure of how many new infections one person will generate during their infectious period. Note that $R_0$ values are approximate, and can vary by outbreak, mode of transmission and location.

Sources: WHO, CDC
In mosquito-borne disease, risk is related to how likely a mosquito is to pick up a new infection and pass it on:
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This is a function of density, longevity,
In mosquito-borne disease, **risk** is related to how likely a mosquito is to pick up a new infection and pass it on:

This is a function of density, longevity, and biting behavior…
Changes in mosquito abundance and behavior influence RISK in predictable ways:

B. What if we double density (m), human biting rate (a) or mosquito survival (p)

Baseline

Transmission Potential

double $m, a, p$

50% $p$

$x2$

BUT these parameters vary widely in space (and time). Outbreaks result when a series of extreme (not mean) conditions align....
Investigate mechanisms that define and maintain mosquito infestations and associated health risks in an urban landscape.
Investigate mechanisms that define and maintain mosquito infestations and associated health risks in an urban landscape.

• Pathogen transmission
• Avoid outdoor activity
Baltimore, MD

median household income  City: $41,385

West Baltimore
Field Samples

5 neighborhoods (2013-2016)
- Adults Mosquitoes on 33 blocks (BGS traps)
- Juvenile mosquitoes: ~1400 parcels
- KAP surveys: ~700 households
Aedes albopictus (Asian tiger)
• Rapid development in containers
• Short dispersal (m)
• Day-time biter
• Known vector of Zika, dengue, chikungunya

Also collect (WNV vectors): Cx pipiens, Cx. restuans, as well as Ae. japonicus, Ae. vexans and Ae. triseriatus adults, plus 4 additional species (including Ae. aegypti) as larvae.
Adults

3X fewer in HIGH SES.

Danielle Bodner, Heather Goodman
More Positive Trash Containers
*Ae. albopictus*

- Mean *Ae. albopictus* adults increased with increasing disused containers at a block-level (*p*=0.002)

Bodner et al. 2016
Ae. albopictus juvenile abundance
Juveniles: Parcel-scale

Discarded (unmanaged)  Functional

*Culex* and *Aedes* pupae presence higher in unmanaged habitat.
3X fewer in HIGH SES.

Ae. albopictus females

Adults per trap night

Mix of trash AND functional container habitat

Low Median High

Low Precipitation

June July Aug Sept
Mainly discarded

- larvae
  - rain
  - larvae

- pupae
  - larvae
  - pupae

Mainly functional

- larvae
  - NS
  - rain
  - larvae

- pupae
  - pupae
  - adults

= MORE ADULT MOSQUITOES
Unless it is dry – then functional containers more likely to stay wet.
BUT …
Do more mosquitoes equal higher risk in a given neighborhood?
Human biting rate and longevity should be even more important indicators of risk.....

LaDeau et al. 2015
Perceived biting is not always a reflection of actual mosquito density...

Scaled by mosquito abundance (2012)

LaDeau et al. 2013
Mosquitoes bite.

• 74% of respondents bothered every day.
• 60% reported changing behavior to avoid mosquitoes. (majority in higher income neighborhoods)

Those who perceived high nuisance were most likely to notify city – which is how control efforts are initiated.
Who is Ae. albopictus biting?

Neighborhood

Low

Median

High

Blood meal
(scaled by abundance)
Who is Ae. albopictus biting:

Neighborhood

Low | Median | High

Blood meal (scaled by abundance)

Reported Daily Nuisance (%)
More habitat for mosquitoes – but fewer people.

More people, more complaints, but fewer mosquitoes.
HIGHEST RISK in neighborhoods where block-to-block variability includes BOTH mosquito habitat and people.

These are often the same places where community greening/gardening is most active.

MANY residents in U.S. cities do not have screens, AC. Many of these same people are less likely to report mosquito nuisance as a problem.
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Planning for a mosquito-borne outbreak – A local perspective

Claudia Riegel, Ph.D.
City of New Orleans Mosquito & Termite Control Board
Objectives

- Increase overall understanding of mosquito control emergencies
- Identify basic principles and concepts of Integrated Pest Management (IPM)
- Identify resources for implementing mosquito control strategies and practices
- Items to consider while preparing to conduct mosquito control for Zika virus and other arboviruses.
Mosquito-borne Diseases

- West Nile virus
- St. Louis encephalitis
- Eastern Equine Encephalitis
- Chikungunya
- Zika
- Malaria
- Dengue
- Yellow fever
Integrated Mosquito Management

- Mosquito Surveillance
- Disease Surveillance
- Source Reduction
- Biological Control
- Physical Control
- Chemical Control
- Resistance Management
- Education and outreach
- Legal channels
Declaration of a Public Health Emergency

- Under the Louisiana Health Emergency Powers Act (LHEPA), the Governor has the sole authority to declare a public health emergency.

- Operational activity of a public health emergency is directed by Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP)

- City of New Orleans coordinates with GOHSEP and Division of Health and Hospitals (DHH)

- New Orleans Health Department is the lead agency for public health emergency preparedness and response in Orleans Parish
City of New Orleans Zika virus - roles

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- New Orleans Mosquito and Termite Control Board is the lead agency for mosquito surveillance and mosquito control in Orleans Parish.
- New Orleans Office of Homeland Security and Emergency Preparedness is the lead agency for coordinating all Orleans Parish agencies during all emergencies including disease outbreaks.
- Many other departments coordinate efforts
  - Office of Communications
  - Department of Sanitation
  - Code Enforcement
  - Safety and Permits
  - NOFD, NOPD, S&WB...
City of New Orleans Zika virus - roles

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A multi-agency approach is required
City of New Orleans Zika virus - roles

- Multiagency approach
  - Each department has a role
  - Address conducive conditions
  - Maximize resources
- Working with several agencies allows for a quick ramp up of personnel to assist mosquito control
- Allows for effective communication to inform the public
Key Partners

- Division of Health and Hospitals
- Governmental and non-governmental organizations (NGOs)
- National, state, regional, and local professional associations
  - American Mosquito Control Association (AMCA)
  - Louisiana Mosquito Control Association (LMCA)
  - National Pest Management Association (NPMA)
- Colleges and universities, including Cooperative Extension System offices (Tulane, LSU, Nicholls State)
- Private industry
  - Pesticide/chemical manufacturers and distributors
  - Pest control companies
- Media
Integrated Pest Management

Surveillance

Public Education
- Reduce conducive conditions
- Eliminate containers holding water
- Repellents

Source Reduction

Biological Control Agents

Pesticides
- Larvicides
- Residual yard treatments
- Adulticides (ground, aerial)
Traps for Adult Mosquitoes

• A variety of mosquito traps, multiple traps will be used to trap target mosquitoes
• Additional cost for traps and labor to run and process the mosquitoes
Assess the high risk areas of the district for additional deployment
Determine additional cost (labor and equipment)
Prepare before the season begins
 Monitoring and Surveillance

- Monitor citizen complaints
  - 311 system
- Addressing inquiries from partners and the public
- Good recordkeeping
- Evaluation and monitoring

Mapped Mosquito Abundance
Education and Outreach

- Multiagency approach
  - CDC, DHH
  - Communications, Health Dept, Mosquito Control
- Unified, easy to understand message
- Prepare press releases
- Education on personal protection
  - Repellant use
  - Physical barriers, screen
  - 5 Ds (Dusk & Dawn, DEET, Dress, and Drain)
- Refer medical questions to qualified agencies (DHH)
Education and Outreach

- Prepare fact sheets
- Risk communication regarding pesticides
- Prioritization explanation
  - Demands for rapid response
- Notification of control activities
  - Bee Keepers/Organic Farmers
  - Chemical sensitive (LDAF)
- Write your districts SOP or plan and communicate it with supporting agencies. Everyone will know their role in the response.
Education and Outreach

City of New Orleans Mosquito, Termite & Rodent Control Board

Mosquitoes: A General Guide

Brendan Carter, Greg Thompson, and Sarah Michaels
City of New Orleans Mosquito, Termite & Rodent Control Board

Mosquitoes can act as annoying biting nuisances and are a public health concern for many in Louisiana and across the world. It is important for residents to understand the mosquito life cycle, the health concerns associated with mosquitoes, and the best methods of controlling and preventing mosquitoes.

Mosquito Identification

Mosquitoes belong to the scientific order Diptera which includes house flies, midges, gnats. The most distinguishing feature of the order is a single set of functional wings, unlike butterflies and dragonflies. The majority of mosquitoes can be distinguished from other Diptera by their long, needle-shaped proboscis which is used to take blood meals from their hosts (Figure 1). Only female mosquitoes take a blood meal.

Overall, there are about 3,500 identified mosquito species in the world. The continental United States is home to about 170 species with at least 64 species in Louisiana. Each mosquito species prefers a particular host for their blood meal which can include birds, humans, or other mammals. Different mosquito species are active at different times of the day and prefer to lay eggs in specific types of habitat, depending on the species.

The main species of concern in Orleans Parish are Culex quinquefasciatus (southern house mosquito), Aedes albopictus (Asian tiger mosquito, Figure 1), and Aedes aegypti (yellow fever mosquito, Figure 2).

Mosquito Life Cycle

The first stage of the mosquito life cycle is the egg (Figure 3), which can be laid on a variety of substrates. Some species prefer to lay their eggs in containers while others prefer standing water or wet ground. Some species like Cx. quinquefasciatus lay their eggs in rafts in standing water, while others like Aedes aegypti and Aedes albopictus lay their eggs singly in containers. After being exposed to water, larva hatch from eggs.

All mosquito larvae must develop in water where they feed and grow through four different larval stages called instars. Mosquito larvae can often be found on top of the water surface where they use their siphon to breathe. Larvae usually prefer shaded, still water. After the 4th instar, mosquito larvae develop into pupae. Pupae are also aquatic, but do not feed.

When ready, the adult mosquito emerges from the pupa. It takes a mosquito only 5-7 days to grow from egg to adult. Once the adult female mosquito has mated and taken a blood meal, the mosquito will be ready to lay eggs and continue the cycle.

What is Zika?

Zika virus disease (Zika) is a disease spread to people primarily through the bite of an infected mosquito. It can also spread when an infected man has sex with his partner. Most people with Zika do not know they have it. Symptoms are usually mild, lasting about a week.

Common Symptoms: Fever, rash, joint pain, and conjunctivitis (red eyes). Other symptoms include headache and muscle pain.

If you see patients with the symptoms ask them where they have traveled.

Diagnostic testing

Preliminary diagnosis is based on the patient’s clinical features, places and dates of travel and activities. Acute Zika virus disease should be suspected if the patient:
1) Travelled to or resided in an area with ongoing transmission of Zika virus within the past 2 weeks
2) Displays more than two symptoms

There are no commercially available diagnostic tests for Zika disease. Zika virus testing is performed by the CDC.

As an arboviral disease, Zika virus is a nationally notifiable condition. Healthcare providers are encouraged to report suspected cases to DHH to facilitate diagnosis and mitigate the risk of local transmission.

Treatment involves supportive care; Aspirin and other non-steroidal anti-inflammatory drugs (NSAIDs) should be avoided until dengue can be ruled out to reduce risk of hemorrhage.

Report any suspected cases to DHH for testing.

On January 15, 2016, the Centers for Disease Control and Prevention (CDC) issued a travel alert for people traveling to regions where Zika virus transmission is ongoing. Pregnant women in any trimester should consider postponing travel to the areas where Zika virus transmission is ongoing. There are travel-related cases in New Orleans but no locally transmitted cases.

The City of New Orleans Mosquito and Termite Control Board (NOMTCB) and the New Orleans Health Department are working with partners to provide you with information about the Zika virus as well as monitoring the mosquito populations.

How to protect yourself

- COVER YOUR SKIN by wearing long-sleeve shirts and long pants. For extra protection, treat clothing with the permethrin insect repellent.
- REMOVE standing water around the home in places such as plant containers, tires, pet dishes and buckets.
- DAYTIME is when mosquitoes that spread Zika virus are aggressive daytime biters, but they can also bite at dawn and dusk.
- EPA-registered insect repellents when used as directed, are proven safe and effective even for pregnant or breastfeeding women.
  - Look for these ingredients: DEET, picaridin, IR3535, OLE, or PMD.
  - Apply insect repellent as directed.
  - Apply sunscreen before insect repellent.
  - Do not apply repellent directly to a child’s face. Spray it into your hand first, then apply.

Travel information

Pregnant women should consider postponing travel to any area where Zika virus transmission is ongoing. If a patient must travel to one of these areas, they should strictly follow steps to prevent mosquito bites. It is safe for pregnant women to use insect repellent.

@NOLAgov | @NOLAhealthdept | www.nola.gov/health
Source Reduction

Mosquitoes – Breeding Sites
Source reduction

- Physical control (source reduction)
  - Preventing mosquito breeding through habitat manipulation
  - Ditching can be used to facilitate drainage and also movement of predators such as fish.
  - Flood water mosquito breeding can be prevented by the use of dikes to keep tidal areas flooded so there is no soil available for egg laying.
  - Removal of standing water
Property access to conduct inspections

• Permission granted by homeowner
• City Code
• New Ordinance giving property owners 24 hrs notice

Tire storage and disposal

• LADEQ – waste tire policy
• City Code – storage and disposal of all tires
• Process and cost for city agencies to collect tires
• Enforcement – numerous agencies involved
Biological Control

- Biological control
  - Fish
  - Copepods
  - Cannibal mosquitoes
- Knowledge
- Resources
- Space
- Manpower
- Equipment
Control Measures

Chemical control

- Ultra-low Volume Adulticiding (ULV)
  - Ground Spraying
  - Aerial Spraying
  - Timing of Application
  - Calibration

- Residual treatments
  - Yard treatments

- Larviciding
  - Different types and formulations
  - Extensive use for arboviral prevention and during intervention
Control Measures

Assessment of insecticides and equipment needed for application

- Budget needed to purchase
- Certified (LDAF) personnel
- Variety of products are kept in inventory
- Lab and field studies with resident populations of mosquitoes
Implement Control Measures

Chemical control
- Pesticide stewardship
- State regulation compliance
- Certified personnel and continuing education
  - Local requirements
  - Personal protective measures
  - Right-to-know, label and MSDS
- Recordkeeping and permits
- Contracts – contingency or provide mosquito control
Resistance Management

- Resistance mechanisms
  - Metabolic resistance
  - Target-site resistance
- Resistance testing
- Implications for mosquito control
- Resistance management in operations
Evaluate Effectiveness

- Pre and post treatment inspection/surveillance
  - Pest population density surveys
- Decrease in service requests
- Decrease the risk of illness and death rates
- Evaluation must be ongoing throughout response and recovery
Calculating the cost of activities related to Zika virus
Conclusion

- New information is constantly available.
- Start preparations early.
- Time is needed to inventory and determine district needs, network with other agencies.
- Addition funding may be required for additional workload.
- Integrated mosquito management approach is required.
- Responding to Zika virus requires a multiagency approach.
- Be transparent and keep the public informed (websites, media, etc.)