Mosquito-Based Surveillance for Arboviruses

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Arbovirus Surveillance

Organized monitoring of levels of:
- Virus activity
- Vector populations (Mosquitoes, ticks, sandflies etc)
- Infections in vertebrate hosts (including humans)
- Weather
- Other factors

AIM: To predict changes in arbovirus transmission dynamics.
Adult Mosquito Collection

- Mosquito Traps:
  - Baited (Light, CO$_2$, Infusion, Ovitraps; Blood meal/Oviposition seeking)
  - Non-baited (resting boxes)

- Aspirator Collections (Resting population)

- Human-landing catches (Blood meal seeking)
CDC-Light Traps

**Strength =** collect a wide range of species
- detection of both primary and secondary vectors
- better understanding of the species composition

**Limitation =** attract host seeking mosquitoes
- large numbers of unfed nulliparous individuals = greatly reduces the likelihood of detecting arboviruses
- not all mosquito species are captured in light traps
- numbers captured may not reflect the relative population sizes of a the particular species in the area
**Gravid Traps**

*Strength* - attract gravid females that have previously taken a blood meal
- greatly increases the likelihood of capturing infected individuals and therefore the likelihood of detecting virus

*Limitation* = primarily capture mosquitoes in the *Cx. pipiens* complex
- provide limited information on species composition
Resting Boxes

Ae. vexans
Cs. inornata
Cs. melanura
Cx. pipiens
Cx. restuans
Cx. tarsalis
Ae. dorsalis
Ae. melanimon
Ae. trivittatus
Ae. hendersoni
Cs. incidens
Cx. salinarius
Animal Baited Traps + Human Landing Catches

**Strengths** - leads to the capture of the mosquito vectors of interest in large numbers

**Limitations** - these methods are similar to the light traps in the sense that they usually capture blood-seeking nulliparous mosquitoes
- limits the chances of capturing infected mosquitoes and detecting virus
- human landing collections may expose catchers to the risk of arboviral infections and require Institutional Review Board (IRB) approval
- animal-baited collections require Institutional Animal Care and Use Committee (IACUC) approval
Specimen Processing

• All efforts should be made to transport mosquitoes alive or in a cool container to maximize the chances of keeping the virus viable
• Field collected mosquitoes must be sorted and identified on a cold surface (chill table) to maximize the chances of detecting virus
• The identified mosquitoes are pooled into groups of 50 or less mosquitoes for arbovirus testing
• The different species, sexes and trap locations are pooled separately to keep track of arboviral infections in different species and arboviral infestation at different locations
• If screening is not done right after mosquito identification, the pooled samples should be stored at \(-70^\circ\text{C}\)
Mosquito Identification
Laboratory Screening

Real-Time RT-PCR

RAMP Test

Vectest

Cell Culture (Virus Isolation)
Mosquito-based surveillance indicators

Vector Abundance (# per trap day/night)

Advantages
- Risk associated with abundance
- Provides measure of IVM effectiveness

Limitations
- Can have high vector numbers with no virus
- For some arboviruses such as WNV outbreaks often occur when density low (population old, but infection rate high)
- Spatial representation requires numerous trap sites
Mosquito-based surveillance indicators

Infection rate in vector population

Advantages
- Provides indicator of incidence of virus in the vector population (Minimum Infection Rate, Maximum Likelihood Estimate)
- Provides useful, quantitative basis for comparison (change in infection rate over time/space)
- Permits variable pool number and size

Limitations
- More complex calculations (software available on CDC WNV web pages)
- Sample size dependent (more specimens tested = better estimate of virus incidence)
Mosquito-based surveillance indicators

Vector Index

Advantages
- Provides indicator of the abundance of infected mosquitoes in an area (VI = proportion infected x number collected per trap night)
- Accommodates multiple vector species in an area
- Permits variable pool number and size

Limitations
- Sample size dependent (more specimens tested = better estimate of infected vector abundance)
- Consistent procedures and effort required for comparability over time and space

*If you are going collect and test mosquitoes, use Vector Index
Relationships Between Vector Index and Human Cases
Chicago 2006

![Graph showing the relationship between vector index and human cases in Chicago 2006.](image-url)
Arbovirus Surveillance Programs

- Simple – easy to carry out
- Economical – cost effective
- Effective – predictive
- Sustainable – long-term

Arbovirus cycles are complex and components vary regionally:
- Thresholds must be determined regionally
- Thresholds are on basis of historical data
Zika Virus Vector Surveillance Tools

• Ovitraps (presence/absence; eggs/trap)
Zika Virus Vector Surveillance Tools

- Larval Surveillance
Zika Virus Vector Surveillance Tools

- Electromechanical aspirators (Resting population)
Zika Virus Vector Surveillance Tools

- Sticky traps for gravid mosquitoes
- AGO = Autocidal Gravid Trap
- Passive!
Zika Virus Vector Surveillance Tools

• Electromechanical traps for blood meal seeking mosquitoes
Zika Vector Control Strategies

- Targeting the immature stages:
  - Oviposition traps (Ovitraps)
  - Larvicide
  - Source reduction
Zika Vector Control Strategies

-Source Reduction
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Hand-held or truck-mounted spraying
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Indoor/outdoor residual spraying
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Autocidal Traps

- AGO
- In2Care
- GAT
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Aerial spraying
Conduct Insecticide Resistance Testing

- Select representative regions in each city
- Screen them for commonly used insecticides twice a year
Results – control traps added to former non-intervention area

Shows convergence to low, steady population 80% reduction afterwards
Results — *Ae. aegypti* density in urban sites without and with AGO control traps

*Ae. aegypti* density is 7-13 times higher in untreated sites.
0.74 – 0.43 mosquitoes/man (40%)

A Reduction in Hospitalized Cases Of Dengue Haemorrhagic Fever In Menado (Sulawesi), Indonesia After Aerial Spraying With ULV Malathion to Control Aedes aegypti
# of *Ae. aegypti* (F) collected per trap night by week

### Epi Week

- **Cluster Suspected**
- **Cluster Confirmed**
- **First aerial adulticide and larvicide**
- **First truck adulticide**

### Number of Human Cases
Miami Beach cases and mosquito abundance

Cluster identified

First truck adulticide
First aerial adulticide and larvicide

Miami Beach cases and mosquito abundance
Examples of transmission thresholds associated with Ae. aegypti

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Disease</th>
<th>Location</th>
<th>Reference rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container Index (CI) &lt; 10%</td>
<td>YF</td>
<td>South America</td>
<td>Connor and Monroe 1923</td>
</tr>
<tr>
<td>House Index (HI) &lt; 5%</td>
<td>YF</td>
<td>South America</td>
<td>Soper 1967</td>
</tr>
<tr>
<td>Breteau Index (BI) &lt; 5</td>
<td>YF</td>
<td>Senegal</td>
<td>Brown 1974</td>
</tr>
<tr>
<td>3 eggs/trap/day</td>
<td>DHF</td>
<td>Thailand</td>
<td>Mogi et al. 1990</td>
</tr>
<tr>
<td>0.5 – 1.5 pupae/person</td>
<td>DEN</td>
<td></td>
<td>Focks et al. 2000</td>
</tr>
<tr>
<td>0.5 females/trap/week (sticky traps)</td>
<td>DEN</td>
<td>Australia</td>
<td>Ritchie et al. 2004</td>
</tr>
<tr>
<td>3 mosquitoes/trap/week (AGO)</td>
<td>CHIKV</td>
<td>PR</td>
<td>Barrera et al. 2017</td>
</tr>
<tr>
<td>2 – 3 mosquitoes/trap/day (BG-Sentinel)</td>
<td>DEN</td>
<td>PR</td>
<td>Barrera et al. 2017</td>
</tr>
</tbody>
</table>
Juan Vicente Gómez

38th President of Venezuela

*Lutzomyia gomezi* (Nitzulescu V., 1931)
Tribal Zika Prevention and Control Workshop:
Mosquito Control, and Public Health Risk Communication

8th Annual Tribal Public Health Summit
National Indian Health Board
Anchorage, AK
June 8, 2017

John Paul Mutebi, PhD¹ and Delight Satter, MPH²
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²Tribal Liaison/SME, SCTF, Zika Response
Senior Advisor, Tribal Research and Program Integration, OSTLTS

Enrolled tribal member: Confederated Tribes of Grand Ronde, OR
Preventing the adverse birth outcomes of congenital Zika syndrome is a primary goal of CDC’s Zika virus response. To increase tribal capacity to respond to Zika virus, CDC has implemented a multi-faceted approach. This Zika Prevention and Control workshop will cover mosquito control and prevention and public health risk communication. The mosquito control portion will focus on environmental sanitation as the primary tool for mosquito management and control. In addition, mosquito surveillance will be emphasized as a tool for evaluating both risk and effect of mosquito control measures. The risk communication portion will include a scenario-based learning exercise on native psychological stressors and resilience-building communication approaches. The workshop will also include a guided overview of online CDC Zika health education resources and self-directed public health trainings through the CDC TRAIN system.
Workshop Learning Objectives

- **Objective 1**: Attendees will be able to identify the role of tribal, state and federal partners in Zika prevention and control.

- **Objective 2**: The attendees will be able to understand the basic principles used in vector surveillance and control programs.

- **Objective 3**: Attendees will be able to identify online CDC Zika resources, including communication resources.

- **Objective 4**: Attendees will be able to navigate to the free online training system CDC TRAIN and identify trainings of interest for self-directed learning, including advanced Risk Communication.

- **Objective 5**: Attendees will participate in a Zika scenario-based learning exercise to evaluate unique tribal members’ psychological stressors (e.g., historical trauma and infectious disease) and select appropriate resilience-building communication approaches.
Workshop Outline

- Mosquito control
- Public health risk communication
Public Health Risk Communication Outline

• Overview

• Scenario-based learning activity
  • Tribal resilience-building communication approaches

• Guided online navigation
  • CDC Zika health education resources
  • CDC TRAIN
**Workshop Learning Theory**

**Adult Learning Theory**

- Activities should demonstrate to the learner where he or she would benefit in their jobs.
- Adults are motivated to learn by both extrinsic and intrinsic motivators.
- Adults enter into a learning experience with a task-centered (or life-centered) orientation.
- Adults become ready to learn when they experience "a need to know".
- Adults have a need to know why they should learn something.
- Adults have a deep need to be self-directing.
- Adults have a greater volume and different quality of experience than youth.

*Activities should be based around real work experiences.*

*Present training with as many options for learning as possible.*

*Design activities that reflect the actual work learners perform.*

*Don't do an information dump.*

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Available online: https://www.cara-corp.com/adult-learning-theory
Risk communication overview
Background

- Risk communication is
  » Relevant for health risks that are part of everyday life
  » Regular and routine information, messages, and engagement with affected people and groups about everyday health risks

- Crisis risk communication:
  » Accurate and effective communication to diverse audiences in emergency situations

WHY SHOULD LOCAL LEADERS COMMUNICATE DURING A DISASTER?

- Sharing good information helps survivors take action
- You are trusted and know your community best
- Sharing good information can reduce fear
- Recognizing other responders helps people work hard
HOW SHOULD LOCAL LEADERS COMMUNICATE DURING A DISASTER?

- Provide the correct information, as fast as possible
- Keep it simple – use simple words and images
- Listen carefully and imagine how others feel
- Stick to the facts you know
WHAT SHOULD LOCAL LEADERS COMMUNICATE DURING A DISASTER?

- Seek information from trusted resources – government, responders, media
- Check your facts and avoid spreading rumors
- Share life-saving information first
- Share widely on different types of social media
Scenario-based learning activity
Background

• Tribal communities have a heightened concern with infectious disease
  » Historic experiences with smallpox, the 1918 Flu pandemic, etc.
  » Higher burden of risk, health consequences, access to care barriers

• Many indigenous communities hold a deep understanding of and connection to the environment
  » Relational worldview that includes self, family, tribe, and environment
    • *Aedes* mosquitoes are a part of that web of relations

• Tailored vector control that is informed by traditional knowledge is critical
Traditional Knowledge

- The Director General of United Nations Educational, Scientific and Cultural Organization (Mayor, 1994) defines traditional knowledge:
  
  » The indigenous people of the world possess an immense knowledge of their environments, based on centuries of living close to nature. Living in and from the richness and variety of complex ecosystems, they have an understanding of the properties of plants and animals, the functioning of ecosystems and the techniques for using and managing them that is particular and often detailed. In rural communities in developing countries, locally occurring species are relied on for many - sometimes all - foods, medicines, fuel, building materials and other products. Equally, peoples knowledge and perceptions of the environment, and their relationships with it, are often important elements of cultural identity.

Cultural Inheritance of Survival and Strength

- “American Indians have a history of survival and strength which is embedded within the cultural inheritance of the community, articulated through culturally based values.”

- The touchstone for public health risk communication activities might build on this “cultural inheritance which provides protective functions that promote resilient capacities and serve as a primary resource for addressing social problems”, such as Zika.

References and further reading

- http://www.astho.org/Programs/Health-Equity/Tribal-Health-Primer/
- http://www.astho.org/Programs/Health-Equity/Knowing-State-Public-Health-Primer/
Group exercise
Guided online overview
Finding CDC Zika Educational Materials, Tools, and Resources

• Navigating the page
• Communication resources
  » Digital resources
• Resources for Zika and pregnancy

CDC Zika Educational Materials, Tools, and Resources

http://www.cdc.gov/zika

Click on Communication Resources
Print Resources

CDC’s Response to Zika

ZIKA: THE BASICS OF THE VIRUS AND HOW TO PROTECT AGAINST IT

About Zika
Zika virus spreads primarily through the bite of an infected Aedes species mosquito (Ae. aegypti and Ae. albopictus). Zika can also be passed through sex from a person who has Zika to his or her sex partners and it can be spread from a pregnant woman to her fetus. People can protect themselves from mosquito bites and getting Zika through sex. This fact sheet explains who’s most affected and why, symptoms and treatment, and how to protect against Zika.

How Zika Spreads
Protect yourself and family from mosquito bites all day and night, whether you are inside or outside. A mosquito becomes infected when it bites a person already infected with Zika. That mosquito can then spread the virus by biting more people.

Zika virus can also spread:
- During sex with a person who has Zika to his or her sex partners.
- From a pregnant woman to her fetus during pregnancy or around the time of birth.
- Through blood transfusion (likely but not confirmed).

Zika Symptoms
Many people infected with Zika won’t have symptoms or will only have mild symptoms. The most common symptoms are fever, rash, joint pain, or red eyes. Other common symptoms include muscle pain and headache. Symptoms can last for several days, to a week. People usually don’t get sick enough to go to the hospital, and they rarely die of Zika. Once a person has been infected with Zika, they are likely to be protected from future infections.

Current Zika Outbreak
Zika outbreaks are currently happening in many countries and territories. The mosquitoes that can become infected with and spread Zika live in many parts of the world, including parts of the United States.

Specific areas where Zika virus is spreading are often difficult to determine and are likely to change over time. If traveling, please visit the CDC Traveler’s Health website for the most recent travel information.

CDC’s Response to Zika

WHAT YOU NEED TO KNOW ABOUT ZIKA

Mosquitoes can give you Zika when they bite:
- Zika can hurt your pregnancy
- Zika symptoms are fever, rash, joint pain and red eyes

Protect yourself from mosquito bites outside:
- Use insect repellent
- Wear long-sleeved shirts and long pants

Get rid of mosquitoes at home:
- Dump water inside and outside
- Use screens on windows and doors
- Cover trashcans and rain barrels

Has your partner been to an area with Zika?
If yes, use condoms every time you have sex.
- Women: Use condoms for at least 8 weeks.
- Men: Use condoms for at least 6 months.

www.cdc.gov/zika

U.S. Department of Health and Human Services Centers for Disease Control and Prevention

Print Resources
Print Resources

What is local transmission?
CDC Zika Digital Resources and Syndication


Digital Resources

Widget

- Zika Widget - Add the Zika Widget to your web site!

Blogs

- Public Health Matters - A collective blog about the exciting public health work of preventing and controlling infectious diseases that result from the interaction of people, animals, and the environment.
- NIOSH Science Blog - A scientific look at workplace safety and health issues from the National Institute for Occupational Safety and Health.

Social Media

Facebook
- CDC
- CDC Travelers Health
- CDC Emergency
- CDC MMWR
- CDC en Español

Twitter
- CDC
- CDC Travelers Health
- CDC Emergency
- CDC MMWR
- CDC en Español

Zika Virus Microsite

- Easily embeddable collection of Zika info for partner websites
- Supplements partner sites with up-to-date, evidence-based content
- Automatically updated on partner sites in real time as CDC updates its Zika webpages
Assessing for Zika during Pregnancy

- All pregnant women should be assessed for possible Zika exposure, signs, and symptoms at each prenatal care visit. They should be asked if they
  - Traveled to or live in an area with risk of Zika
  - Had sex without a condom with a partner with potential exposure to Zika

Developing Tools for Healthcare Providers

CDC's Response to Zika

Doctor's Visit Checklist: For Pregnant Women Who Traveled to an Area with Zika

If you are pregnant and traveled to an area with Zika, you should talk to your doctor or other healthcare provider, even if you don’t feel sick. Bring this checklist to your visit to make sure you don’t forget to discuss anything important.

Here are some topics and questions you may want to discuss with your doctor or other healthcare provider:

- When did you travel to an area with Zika?
- What did you travel to?
- In what trimester was your pregnancy when you traveled to an area with Zika?
- Did you have any symptoms of Zika your trip or within 2 weeks of returning?
- The most common symptoms of Zika are fever, rash, joint pain, and red eyes.
- Should you be tested for Zika virus?
- If you have symptoms of Zika, testing for Zika should be done within 7 days of when the symptoms began.
- In some cases, if you do not have symptoms of Zika, testing for Zika can be offered.
- Do you need an ultrasound?
- Do you need to be referred to a maternal-fetal medicine specialist?
- How can you prevent sexual transmission of Zika virus?

* Check http://www.cdc.gov/travel/vaccines for the most up-to-date travel recommendations.

Resource List:

www.cdc.gov/Zika

*Free materials available in English, Spanish and other languages
Pretest Counseling Materials & Scripts

PRETESTING COUNSELING CONVERSATION GUIDE FOR HEALTHCARE PROVIDERS
For Pregnant Women with Possible Exposure to Zika or Symptom Onset 2-12 Weeks Ago

This guide describes recommendations for conducting counseling for pregnant women if they or their sex partner live in or have recently traveled to an area with active Zika transmission. CDC recommends testing for pregnant women who may have been exposed to Zika, whether or not they have symptoms. This material includes sample scripts to guide discussions with your patients about the complexity of Zika testing and the testing process with patients. Because a lot of content is focused on testing, make additional information available to support your counseling and educate your patients about what they are being told.

Pregnant women coming in for Zika testing may feel worried or anxious. Support them by providing them with clear and easy to understand information, avoiding technical terms, and expressing empathy by acknowledging your concerns and feeling during pretesting counseling.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Sample Script</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provide the patient with information on the complexity of Zika testing.</strong></td>
<td></td>
</tr>
</tbody>
</table>

Use one or both of the following sentences to begin the discussion depending on the clinical scenario:  
1) You may be at risk of having Zika since you or your sex partner recently traveled to an area where Zika virus is spreading by mosquitoes more than two weeks ago. (For those without symptoms: You could be at risk even if you’re not pregnant or your partner does not have symptoms.)

How do I know if I have Zika? Zika virus is spread by mosquitoes. You may be at risk if you have traveled to an area where Zika virus is spreading by mosquitoes more than two weeks ago. (For those without symptoms: You could be at risk even if you’re not pregnant or your partner does not have symptoms.)

2) You may be at risk of having Zika because within the past 2-12 weeks you had sex with a partner who traveled to an area where Zika virus is spreading by mosquitoes more than two weeks ago. (For those without symptoms: You could be at risk even if you’re not pregnant or your partner does not have symptoms.)

Based on the information you’ve told me, I think it is best to discuss forward with you testing for Zika. Before we begin, I would like to provide you with some helpful information on what to expect throughout this process.

Patients should be informed that more than one Zika test may be required before a final result is determined.

You may only need one test to find out whether you have Zika, however, you may need up to three different tests before we can find out whether you have Zika or not because the result of one test may not tell the whole story, and you may need to get additional tests to find out if you really had a Zika virus infection. We want to be sure we take all of the necessary steps to make sure your results are accurate. Each test can take different amounts of time to resolve results. I know this can be frustrating, but your healthcare provider is here to answer any questions you may have.

- Reassure the patient that this method of testing is normal.
- Consider providing the fact sheet: “What You Should Know about Zika Virus Testing for Pregnant Women Who May Have Been Exposed to Zika 2-12 Weeks Ago.”

Patients should be informed that it can be challenging to understand test results.

It can be hard to understand Zika test results for a number of reasons. Mosquitoes can carry many viruses, like dengue virus, which is very similar to Zika. So if someone has been infected with these other viruses in the past, it may be difficult to know which virus you have been infected with. It is possible that the test will:

1) Detect signs that your body cleared viruses, other than Zika, from your system.
2) Detect signs that your body currently cleared Zika virus from your system, or
3) Detect that you currently have Zika.

Therefore, we may need to do additional testing to figure out whether you actually have or had Zika. Once I know which virus infected you, I will know how best to care for you during your pregnancy.

- Ask the patient if they have any questions before you move forward with providing information on the testing process.

Pediatric Evaluation and Follow-up Tools

Initial Evaluation and Outpatient Management During the First 12 Months of Life for Infants with Possible Congenital Zika Virus Infection

Registry Reporting for Tribal Healthcare Providers

Download at:
Materials for Families Affected by Zika

Other federal resources

- DHHS Disaster Information Management Research Center
  » Link: https://disasterinfo.nlm.nih.gov/dimrc/zikavirus

- SAMHSA
  » https://www.samhsa.gov/dtac/zika
Non-federal resources

- International resources
- State resources
- CDC funded partners
  - NIHB resources
  - Academic resources
- Tribal resources
International resources (example)

• World Health Organization
  » Psychosocial support for pregnant women and for families with microcephaly and other neurological complications in the context of Zika virus: Interim guidance for health-care providers
State and local resources (examples)

• Arizona Department of Health Services
  » Fight the Bite Toolkit, etc.
  » http://azdhs.gov
Enter “Risk Communication”
Multiple trainings available online

CDC CERC Training will show up near bottom of page
Conclusion

- Thank you for sharing tribal views
  - On Zika health issues and challenges
  - Share examples of partnering and collaboration
  - Tribal resources and gaps
- CDC, tribes, and partners are actively collaborating in Zika response
- Further improvements can be made with new, effective, and culturally responsive ways based on information gathered at this summit

- Masi – Thank-you!
- Contact information: dsatter@cdc.gov
CDC’S Response to Zika

For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
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- Vector populations (Mosquitoes, ticks, sandflies etc)
- Infections in vertebrate hosts (including humans)
- Weather
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AIM: To predict changes in arbovirus transmission dynamics.
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  - Non-baited (resting boxes)

- Aspirator Collections (Resting population)

- Human-landing catches (Blood meal seeking)
**CDC-Light Traps**

**Strength = collect a wide range of species**
- detection of both primary and secondary vectors
- better understanding of the species composition

**Limitation = attract host seeking mosquitoes**
- large numbers of unfed nulliparous individuals = greatly reduces the likelihood of detecting arboviruses
- not all mosquito species are captured in light traps
- numbers captured may not reflect the relative population sizes of the particular species in the area
Gravid Traps

**Strength** - attract gravid females that have previously taken a blood meal
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**Limitation** = primarily capture mosquitoes in the Cx. pipiens complex
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Cs. inornata
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Cx. salinarius
Animal Baited Traps + Human Landing Catches

**Strengths** - leads to the capture of the mosquito vectors of interest in large numbers

**Limitations** - these methods are similar to the light traps in the sense that they usually capture blood-seeking nulliparous mosquitoes

- limits the chances of capturing infected mosquitoes and detecting virus
- human landing collections may expose catchers to the risk of arboviral infections and require Institutional Review Board (IRB) approval
- animal-baited collections require Institutional Animal Care and Use Committee (IACUC) approval
Trap Locations In Maricopa CO, AZ
Specimen Processing

• All efforts should be made to transport mosquitoes alive or in a cool container to maximize the chances of keeping the virus viable.

• Field collected mosquitoes must be sorted and identified on a cold surface (chill table) to maximize the chances of detecting virus.

• The identified mosquitoes are pooled into groups of 50 or less mosquitoes for arbovirus testing.

• The different species, sexes and trap locations are pooled separately to keep track of arboviral infections in different species and arboviral infestation at different locations.

• If screening is not done right after mosquito identification, the pooled samples should be stored at -70°C.
Mosquito Identification
Laboratory Screening

- Real-Time RT-PCR
- RAMP Test
- Vectest

Cell Culture (Virus Isolation)
Mosquito-based surveillance indicators

Vector Abundance (# per trap day/night)

Advantages
- Risk associated with abundance
- Provides measure of IVM effectiveness

Limitations
- Can have high vector numbers with no virus
- For some arboviruses such as WNV outbreaks often occur when density low (population old, but infection rate high)
- Spatial representation requires numerous trap sites
Mosquito-based surveillance indicators

Infection rate in vector population

Advantages
- Provides indicator of incidence of virus in the vector population (Minimum Infection Rate, Maximum Likelihood Estimate)
- Provides useful, quantitative basis for comparison (change in infection rate over time/space)
- Permits variable pool number and size

Limitations
- More complex calculations (software available on CDC WNV web pages)
- Sample size dependent (more specimens tested = better estimate of virus incidence)
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Vector Index

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- Provides indicator of the abundance of infected mosquitoes in an area (VI = proportion infected x number collected per trap night)
- Accommodates multiple vector species in an area - permits variable pool number and size

Limitations
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- Consistent procedures and effort required for comparability over time and space

*If you are going collect and test mosquitoes, use Vector Index
Relationships Between Vector Index and Human Cases
Chicago 2006

The graph shows the relationship between the vector index and human cases in Chicago in 2006. The x-axis represents the weeks of the year, and the y-axis represents the number of human cases and infection index. The graph indicates a significant increase in the vector index and human cases during the summer months, particularly in August, followed by a decrease in September.
Arbovirus Surveillance Programs

- Simple – easy to carry out
- Economical – cost effective
- Effective – predictive
- Sustainable – long-term

Arbovirus cycles are complex and components vary regionally:
- Thresholds must be determined regionally
- Thresholds are on basis of historical data
Zika Virus Vector Surveillance Tools

- Ovitraps (presence/absence; eggs/trap)
Zika Virus Vector Surveillance Tools

-Larval Surveillance
Zika Virus Vector Surveillance Tools

- Electromechanical aspirators (Resting population)
Zika Virus Vector Surveillance Tools

- Sticky traps for gravid mosquitoes
- AGO = Autocidal Gravid Trap
- Passive!
Zika Virus Vector Surveillance Tools

- Electromechanical traps for blood meal seeking mosquitoes
Zika Vector Control Strategies

- Targeting the immature stages:
  - Oviposition traps (Ovitraps)
  - Larvicide
  - Source reduction
-Source Reduction
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Hand-held or truck-mounted spraying
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Indoor/outdoor residual spraying
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Autocidal Traps

AGO  In2Care  GAT
Zika Vector Control Strategies

- Targeting adult mosquitoes:
  - Aerial spraying
Conduct Insecticide Resistance Testing

- Select representative regions in each city
- Screen them for commonly used insecticides twice a year
Results – control traps added to former non-intervention area

Shows convergence to low, steady population 80% reduction afterwards
Results – *Ae. aegypti* density in urban sites without and with AGO control traps

*Ae. aegypti* density is 7-13 times higher in untreated sites
A Reduction in Hospitalized Cases Of Dengue Haemorrhagic Fever In Menado (Sulawesi), Indonesia After Aerial Spraying With ULV Malathion to Control Aedes aegypti

L.S. Self, M.D.*
M.J. Nelson, M.D.*
B. Theos, M.D.**
G. Wiseso, M.D.***

J. Med. Ass. Thailand
Vol. 60 No. 10
October 1977

0.74 – 0.43 mosquitoes/man (40%)
The graph illustrates the number of *Ae. aegypti* (F) collected per trap night by week, with two different bars and lines indicating clusters of suspected and confirmed cases. The shaded bars represent the number of human cases.

### Graph Details:
- **x-axis**: Epi Week
- **y-axis**: Number of Human Cases
- **Legend**:
  - Cluster Suspected
  - Cluster Confirmed
  - First aerial adulticide and larvicide
  - First truck adulticide

### Observations:
- There is a significant increase in the number of collected mosquitos during Epi Week 29.
- The peak for both clusters occurs around Epi Week 29.
- The number of human cases follows a similar pattern to the mosquito collections.
- The first aerial adulticide and larvicide application is marked as occurring in Epi Week 29.
- The first truck adulticide treatment is marked as occurring later in the week.

### Key Points:
- The graph highlights the correlation between mosquito collections and the incidence of human cases.
- Interventions such as aerial adulticides and larvicides are indicated to manage the mosquito population.
- The effectiveness of these interventions can be monitored through the graph.
Miami Beach cases and mosquito abundance

- Number of human cases
- # of Ae aegypti (F) collected per trap night by week
- Epi Week
- Miami Beach (North of 28th St.)
- Miami Beach (South of 28th St.)
- First aerial adulticide and larvicide
- First truck adulticide and larvicide
- Cluster Identified
### Examples of transmission thresholds associated with *Ae. aegypti*

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Disease</th>
<th>Location</th>
<th>Reference rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container Index (CI) &lt; 10%</td>
<td>YF</td>
<td>South America</td>
<td>Connor and Monroe 1923</td>
</tr>
<tr>
<td>House Index (HI) &lt; 5%</td>
<td>YF</td>
<td>South America</td>
<td>Soper 1967</td>
</tr>
<tr>
<td>Breteau Index (BI) &lt; 5</td>
<td>YF</td>
<td>Senegal</td>
<td>Brown 1974</td>
</tr>
<tr>
<td>3 eggs/trap/day</td>
<td>DHF</td>
<td>Thailand</td>
<td>Mogi et al. 1990</td>
</tr>
<tr>
<td>0.5 – 1.5 pupae/person</td>
<td>DEN</td>
<td></td>
<td>Focks et al. 2000</td>
</tr>
<tr>
<td>0.5 females/trap/week (sticky traps)</td>
<td>DEN</td>
<td>Australia</td>
<td>Ritchie et al. 2004</td>
</tr>
<tr>
<td>3 mosquitoes/trap/week (AGO)</td>
<td>CHIKV</td>
<td>PR</td>
<td>Barrera et al. 2017</td>
</tr>
<tr>
<td>2 – 3 mosquitoes/trap/day (BG-Sentinel)</td>
<td>DEN</td>
<td>PR</td>
<td>Barrera et al. 2017</td>
</tr>
</tbody>
</table>
Juan Vicente Gómez

38th President of Venezuela

Lutzomyia gomezi (Nitzulescu V., 1931)
Scenario based learning Instructions

*Use your expert knowledge of American Indian and Alaska Native people*

Developing a communications plan is a part of Risk Communication. The basic steps include:

1. **Identify the purpose of your communication**
2. **Identify your audience**
3. **Plan and design your message**
4. Consider your resources
5. Plan for obstacles and emergencies
6. Strategize how you’ll connect with the media and others who can help you spread your message
7. Create an action plan
8. Decide how you’ll evaluate your plan and adjust it, based on the results of carrying it out
Move into small groups
1. Identify the **purpose of your communication** from the scenario options below (or create your own) – 5 minutes

Scenario 1  
Individual change – keeping self and family safe  
Vector reduction

Scenario 2  
Individual/Family change – preventing sexual transmission  
Safe sex, family planning

Scenario 3  
Community level change – keeping homes and community venues safe  
Vector reduction

Scenario 4  
Individual – pregnancy exposure  
Supporting client through screening experience
2. **Identify your audience** – 5 minutes
3. **Plan and design your message** – plan - 10 minutes

Discuss how you think your target audience will feel
Discuss psychological stressors (historical trauma and infectious disease) that might impact health behaviors

What scares you about health communication on this issue?
   Bring self awareness into the discussion and support each other in the small group
3. Plan and design your message – plan - 5 minutes

- Using information from your discussion begin to shape a key message considering:
  - Content
  - Mood
  - Language
  - Resilience-building communication
### 3. Plan and design your message - design

#### Communications products

<table>
<thead>
<tr>
<th>Written reports</th>
<th>News stories, columns, and reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report summaries or Executive Summaries</td>
<td>Press releases and press conferences</td>
</tr>
<tr>
<td>Community Forums</td>
<td>Presentations or presence at local events and local and national conferences, fairs, and other gatherings</td>
</tr>
<tr>
<td>Tribal Council Reports</td>
<td>Community outreach</td>
</tr>
<tr>
<td>Fact sheets</td>
<td>Community events</td>
</tr>
<tr>
<td>Policy briefs</td>
<td>Public demonstrations</td>
</tr>
<tr>
<td>Posters</td>
<td>Word of mouth</td>
</tr>
<tr>
<td>Fliers and brochures</td>
<td>Music</td>
</tr>
<tr>
<td>Newsletters</td>
<td>Exhibits and public art</td>
</tr>
<tr>
<td>Promotional materials</td>
<td>TV and Public Service Announcements (PSAs)</td>
</tr>
<tr>
<td>Comic books or other reading material</td>
<td>Theater and interactive theater</td>
</tr>
<tr>
<td>Social media</td>
<td>Letters to the Editor</td>
</tr>
</tbody>
</table>
Additional resources

- Community Toolbox which has a wide range of useful tools
  http://ctb.ku.edu/en
- http://www.phf.org/resourcestools/Pages/Planning_Before_You_Communicate_Tool.aspx
- https://www.hsph.harvard.edu/ecpe/programs/applied-risk-communication-for-the-21st-century/