

NC Zika Virus Response & Challenges

NC Local Health Directors Legal Conference
8 June 2017

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Introduction

- Historical perspective of Mosquito borne disease surveillance and control
- Arboviral disease surveillance in NC
- DPH Vector borne disease program
- DPH Zika case management
- Developing mosquito management infrastructure, and surveillance
- Statewide container inhabiting Aedes survey
- Final thoughts...

Learning Objectives

- To gain a historical perspective of NC Mosquito borne disease surveillance and control.
- To review the life cycle and epidemiology of Zika virus.
- To understand the relative risk of Zika virus infections to North Carolina inhabitants.
- To understand the concepts of integrated mosquito management.

Learning Objectives

- To understand some of the legal challenges and issues in conducting investigations and intervening in potential or real Zika outbreaks.

Malaria Control 1930s

- In 1937 the Division of Epidemiology made malaria a reportable disease and began to emphasize the control of malaria by encouraging accurate reporting of the disease, identifying high incidence areas, supporting the drainage of swamps in those areas, and promoting community wide sanitation projects financed by Works Progress Administration (WPA) funds
 - Twenty-seventh Biennial Report Of The North Carolina State Board Of Health July 1, 1936—June 30, 1938
 - <http://dc.lib.unc.edu/cdm/compoundobject/collection/nchh/id/862774/rec/22>



Draining
the
Swamp!

Malaria Decline 1940s

- Reports are presented for the last 2 malaria outbreaks in N. Carolina, one caused by *P falciparum*, the other by *P. vivax*, which occurred in 1943
- Despite the lack of adequate control measures the disease did not reappear after 1944
 - Schoof, Ashton : The decline and last recorded outbreaks of malaria in North Carolina. Jour Natl Malaria Soc 1951. 10(4): 306-317

Malaria Eradicated 1950s

- Malaria which was formerly a scourge in this State has become practically non-existent.
- We examined only 418 specimens of blood during the current biennium compared with 731 for the previous period.
- In only two specimens were parasites found during the period 1954-1956.
 - Thirty-Sixth Biennial Report of the North Carolina State Board of Health July 1, 1954—June 30, 1956
 - <http://dc.lib.unc.edu/cdm/compoundobject/collecti on/nchh/id/855006/rec/30>

1955 Salt Marsh Mosquito Study Commission

- Now that our principal concern with malaria is the prevention of reintroduction rather than the application of control measures in areas of high endemicity, we have time and facilities to devote to pest mosquitoes
- The duty of this Commission is to make a study of salt-marsh mosquito problems in eastern North Carolina, investigate the capacity of each county, town and city to provide funds for control operations, and make a report of its findings, along with recommendations, to the Governor
- With no legislative appropriation for the coming season, operations will again be dependent upon funds given us from the Contingency and Emergency Fund
- It is hoped, however, that the 1957 General Assembly will appropriate a sizeable sum and enact legislation that will provide for the formation of mosquito control districts similar to those in other states
- Mosquito News Vol. 16, No. 2, June 1956

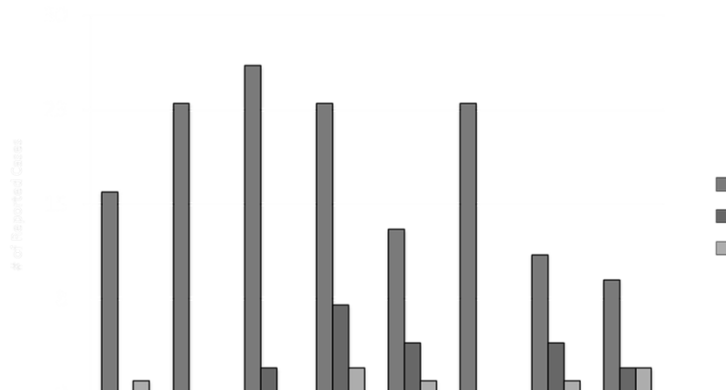
North Carolina General Statutes: Mosquito and Vector Control

- 130A-352. Creation and purpose of mosquito control districts.
 - For the purpose of protecting and promoting the public health and welfare by providing for the control of mosquitoes and other arthropods of public health significance, mosquito control districts may be created in accordance with the provisions of this Part. A mosquito control district may be comprised of one or more contiguous counties or contiguous parts of one or more counties. (1957)
- 130A-353. Nature of district; procedure for forming districts
- 130A-354. Governing bodies for mosquito control districts
- 130A-355. Corporate powers
- 130A-356. Adoption of plan of operation

2011 NC HOUSE BILL 200

- The Vector Control Program and the Tick Control Program within the Division of Environmental Health of the Department of Environment and Natural Resources are abolished.
- Further, any equipment that the State loaned to any local health department as part of the Vector Control Program that is in the possession of the local health department shall be retained by that local health department, and the ownership of that equipment shall be transferred from the State to that local health department

Confirmed & Probable Endemic Arboviral Conditions by Year Onset, NC



Encephalitis, arboviral, LAC Average Incidence by County, 2011 - 2015



Mosquito Control Historically Linked to Pests, not Disease Incidence

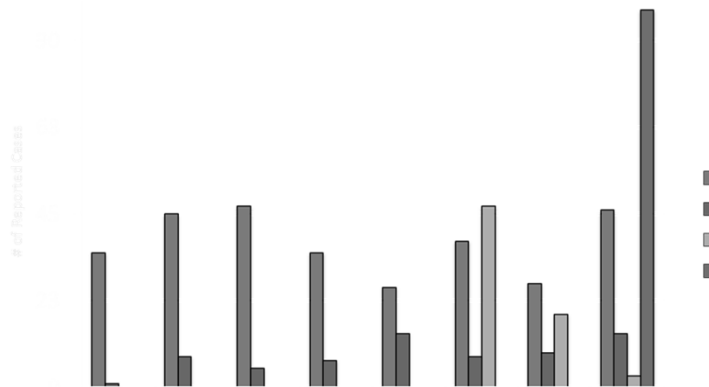
- La Crosse encephalitis (LACE) is the most commonly reported arboviral infection acquired in NC
- LACE is endemic in western/southwestern NC
- Mosquito Control Programs (MCP) most abundant in eastern NC to address
 - Flood plain/salt marsh mosquitoes
 - Eastern equine encephalitis (EEE)

Other Mosquito Borne Infections

	Reportable	1° Vector	Geography	Genus	Reservoir
Dengue	Y* **	<i>Aedes aegypti</i>	Multiple Continents	Flavivirus	Human & NHP
Chikungunya	Y* **	<i>Aedes aegypti</i>	Multiple Continents	Alphavirus	Human & NHP
Zika	Y* **	<i>Aedes aegypti</i>	Multiple Continents	Flavivirus	Human & NHP
Yellow Fever	Y* **	<i>Aedes aegypti</i>	Multiple Continents	Flavivirus	Human & NHP
Malaria	Y* **	<i>Anopheles spp</i>	Multiple Continents	Plasmodium	Human

* Per 10A NCAC 41A .0101 each condition is individually reportable
 ** Transmission not documented in NC

C & P Travel Associated Mosquito Borne Disease Cases by Year Onset, NC



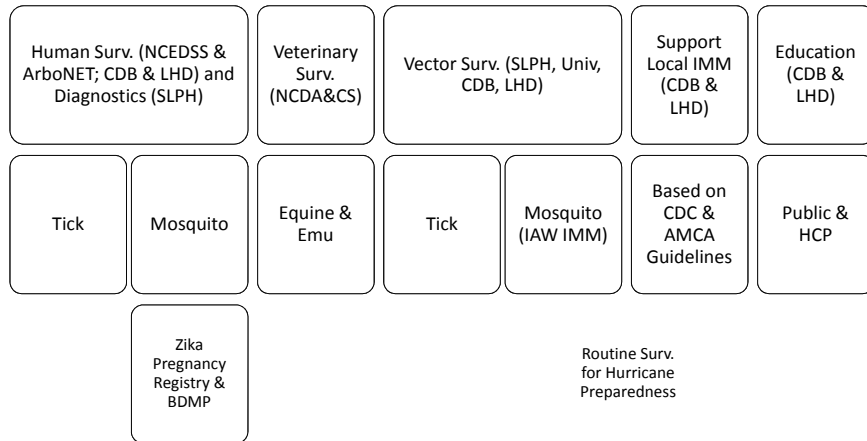
North Carolina Vector borne Disease Management

Developing capacity in the Communicable Disease Branch, Environmental Health Section and State Laboratory of Public Health

Megan Davies, Evelyn Foust, Carl Williams, Holly Watkins, Larry Michael, Scott Zimmerman
3/28/2016

<http://epi.publichealth.nc.gov/cd/vectorVectorborneDiseaseProgramWhitePaper.pdf>

NC VBD Program



Zika Virus (Zika)

- Single stranded RNA virus
- Genus *flavivirus*, family *Flaviviridae*
- Closely related to dengue, yellow fever, Japanese encephalitis, and West Nile viruses
- Primarily transmitted through the bite of an infected *Aedes* species mosquito (*Ae. aegypti* and *Ae. albopictus*)



Aedes aegypti



Aedes albopictus

Where has Zika virus been found?

- Before 2015, Zika outbreaks occurred in Africa, Southeast Asia, and the Pacific Islands.
- Currently is a risk in many countries and territories.
- For the most recent case counts in the US visit CDC's Zika website: [cdc.gov/zika](http://www.cdc.gov/zika)

<http://www.cdc.gov/zika/geo/index.html>

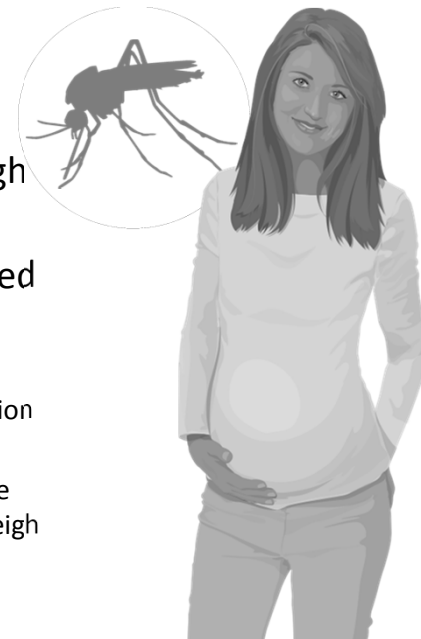
Transmission

- Bite from an infected mosquito
- Maternal-fetal
 - Periconceptional
 - Intrauterine
 - Perinatal
- Sexual transmission from an infected person to his or her partners
- Laboratory exposure



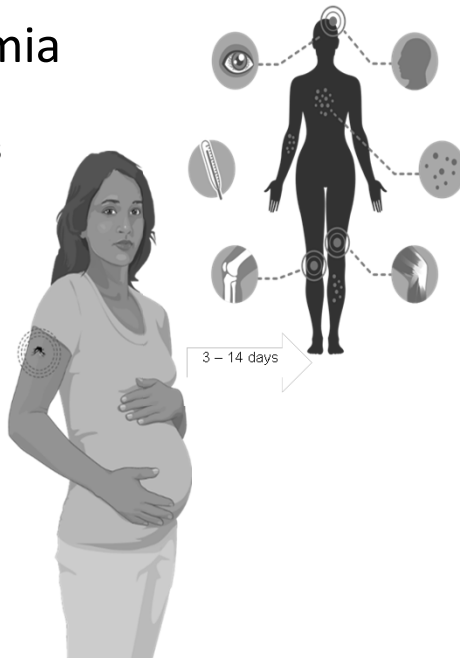
Transmission

- Zika may be spread through blood transfusion.
- Zika virus has been detected in breast milk.
 - There are no reports of transmission of Zika virus infection through breastfeeding.
 - Based on available evidence, the benefits of breastfeeding outweigh any possible risk.



Incubation and viremia

- Incubation period for Zika virus disease is 3–14 days.
- Zika viremia ranges from a few days to 1 week.
- Some infected pregnant women can have evidence of Zika virus in their blood longer than expected.
- Virus remains in semen and urine longer than in blood.



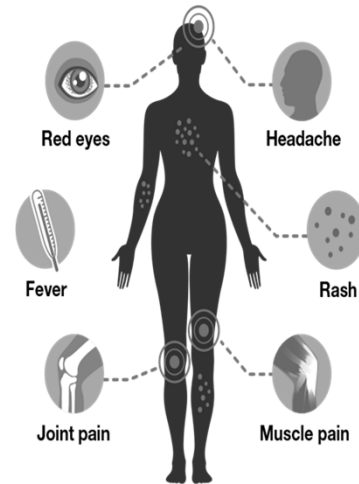
Zika virus clinical disease course and outcomes

- Clinical illness is usually mild.
- Symptoms last several days to a week.
- Severe disease requiring hospitalization is uncommon.
- Fatalities are rare.
- Research suggests that Guillain-Barré syndrome (GBS) is strongly associated with Zika; however only a small proportion of people with recent Zika infection get GBS.



Symptoms

- Many infections are asymptomatic
- Acute onset of fever
- Maculopapular rash
- Headache
- Joint pain
- Conjunctivitis
- Muscle pain



Zika and pregnancy outcomes

- Zika virus infection during pregnancy is a cause of microcephaly and other severe birth defects.
- All infants born to mothers with laboratory evidence of Zika infection during pregnancy should receive a comprehensive physical exam.
- **Congenital Zika syndrome** is a distinct pattern of birth defects among fetuses and infants infected before birth.



Congenital Zika syndrome

Congenital Zika syndrome is associated with five types of birth defects that are either not seen or occur rarely with other infections during pregnancy:

- **Severe microcephaly** (small head size) resulting in a partially collapsed skull
- **Decreased brain tissue** with brain damage (as indicated by a specific pattern of calcium deposits)
- **Damage to the back of the eye** with a specific pattern of scarring and increased pigment
- **Limited range of joint motion**, such as clubfoot
- **Too much muscle tone** restricting body movement soon after birth



Not every infection will lead to birth defects

- It's important to remember that even in places with Zika, women are delivering infants that appear to be healthy.
- Many questions remain about the timing, absolute risk, and the spectrum of outcomes associated with Zika virus infection during pregnancy.
- More lab testing and other studies are planned to learn more about the risks of Zika virus infection during pregnancy.



But the Question Generating the Most
Interest...

Is *Aedes aegypti* present in NC?

Zika Virus Vectors:
Aedes (stegomyia) Mosquitoes

- *Aedes* species mosquitoes
 - *Ae aegypti* more efficient vectors for humans
 - *Ae albopictus*
- Also transmit dengue and chikungunya and YF viruses
- Lay eggs in domestic water-holding containers
- Live in and around households
- Aggressive daytime biters



Aedes aegypti

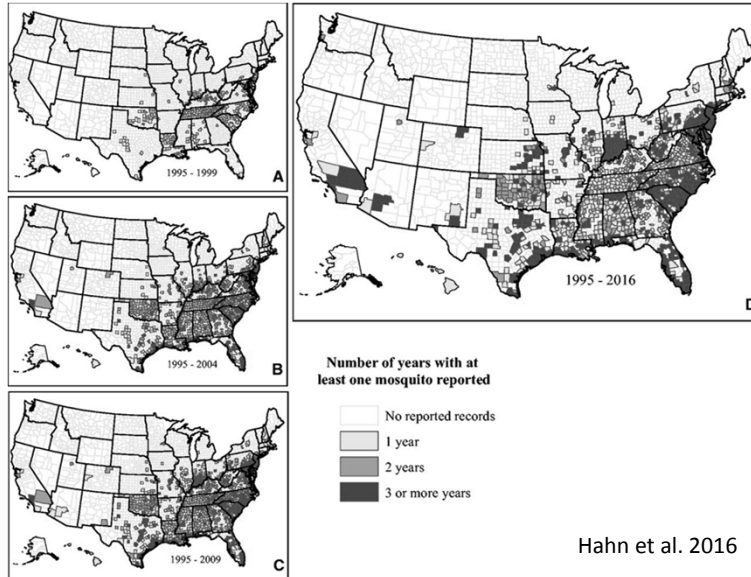


Aedes albopictus

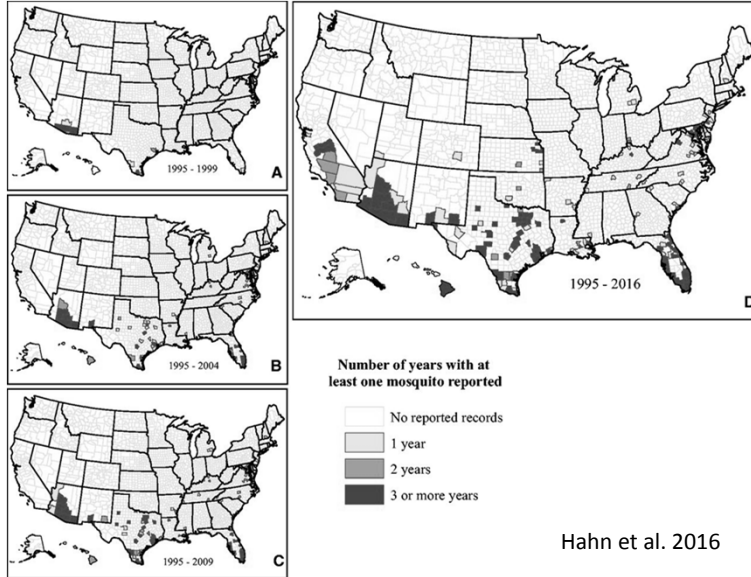
***Aedes aegypti* and *Aedes albopictus* Mosquitoes: Geographic Distribution in the United States**



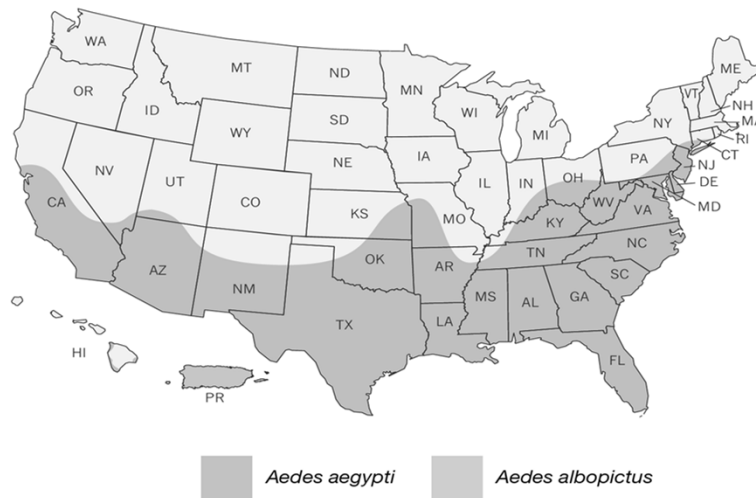
Distribution of *Aedes albopictus*



Distribution of *Aedes aegypti*



"Estimated Potential Range of *Aedes aegypti*"



<http://www.cdc.gov/zika/vector/range.html>

Ecologic Context Required for Local Zika Transmission by Mosquito

1. High number of vector mosquitoes (i.e., high temperatures and high rainfall – 3 to 4 summer months)
2. High number of “exposure” hours (i.e., hours humans are outside exposed to mosquitoes, or mosquitoes are inside with humans)
3. Infected traveler is bit in NC during the short time there is active virus in his/her blood*
4. The infected mosquito lives long enough to grow virus within it (5+ days in warm weather), AND it bites another human

Integrated Mosquito Management Methods

IMM uses a combination of methods to prevent and control mosquitoes that spread viruses, like Zika, dengue, and chikungunya. IMM is based on an understanding of mosquito biology, the mosquito life cycle, and the way mosquitoes spread viruses.
- https://www.cdc.gov/zika/vectorintegrated_mosquito_management.html

Integrated Mosquito Management is a comprehensive mosquito prevention/control strategy that utilizes all available mosquito control methods singly or in combination to exploit the known vulnerabilities of mosquitoes in order to reduce their numbers to tolerable levels while maintaining a quality environment.

- American Mosquito Control Association 12-2-2009

IMM at Someone's House



Do you have a licensed Public Health Pesticide Applicator?



Do you have right of entry?



Is your staff educated on principles of Mosquito surveillance?

Zika Vector Survey

- This survey is designed to update distribution records of container-inhabiting *Aedes* species in selected North Carolina counties.
- Particular effort is focused on determining the presence of *Aedes albopictus* and/or *Aedes aegypti* within counties that are in metropolitan statistical areas (MSAs), or other areas likely to be at higher risk for transmission of arboviruses by *Aedes* mosquitoes.
- In addition to larval and pupal surveys, a series of ovitrap surveys will be used at key MSAs to establish temporal trends and relative species abundance while increasing the probability of detecting the presence of *Aedes aegypti* at surveyed locations.

2016 Ovitrap Participants

- East Carolina University (Richards)
 - Brunswick, Onslow, New Hanover, Pitt, Gates, Currituck, (DOD: Camp Lejeune, SJAFB)
- North Carolina State University (Reiskind)
 - Edgecombe, Wake, Forsyth, Guilford, Cumberland
- Western Carolina University (Byrd)
 - Buncombe, Cabarrus, Henderson, Haywood, Mecklenburg, Transylvania



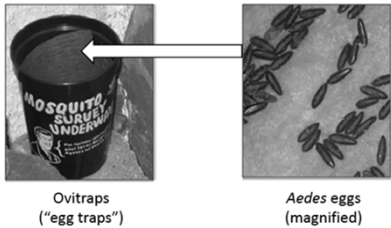
Survey Technique

- **Larval Collections:** Immature mosquitoes will be sampled from “artificial” containers during May-October with the intent of documenting the presence of vector species in at least 30 different locations within a county, as feasible given the local resources.



Survey Techniques

- Ovitrap Collections:** Container-inhabiting mosquito eggs will be collected using “ovitrap”. Weekly or bi-weekly collections are being sent to the university labs for hatching and identification.



Ovitrap Results (10/2016)

University	Eggs	Identified	<i>Ae. albopictus</i>	<i>Ae. triseriatus</i>	<i>Ae. japonicus</i>	<i>Ae. aegypti</i>
ECU	88,556	15,904	14,922	719	263	0
NCSU	123,164	24,699	22,370	1,584	745	0
WCU	66,482	21,975	13,272	4,475	4,228	0
Totals	278,202	62,637	50,564 (80.7%)	6,778 (10.8%)	5,236 (8.4%)	0


To date, more than 278,202 *Aedes spp.* eggs have been received by the universities and 62,637 mosquitoes have been identified to species by microscopy. At present, no *Aedes aegypti* have been identified in the submissions. More than 99.9% of the ovitrap collections are represented by 3 species: 80.7% (n=50,564) of the identified *Aedes* are *Aedes albopictus*, 10.8% (n=6,778) are *Aedes triseriatus*, and 8.4% (n=5,236) are *Aedes japonicus*. The percentages of *Aedes japonicus* and *Aedes triseriatus* vary regionally, but *Aedes albopictus* is the primary container inhabiting *Aedes* in the participating counties according to the ovitrap data. Temporal trends and relative abundance data will be assessed both regionally and at a county level for distribution in Dec 2016.

Preliminary Data

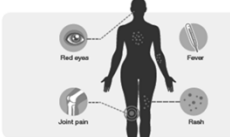
TESTING

CDC's Response to **Zika**

WHEN TO TEST FOR ZIKA VIRUS



As a healthcare provider, you decide if a patient should be tested for Zika virus infection. The algorithm below will help you determine whether or not to test your patient for Zika virus infection. For information on which test to use, see [CDC's interim guidance](#).



Red eyes
Fever
Joint pain
Rash

If your patient is

- Experiencing or has recently experienced symptoms of Zika*
- An asymptomatic pregnant woman

Ask the following questions

```
graph TD
    Q1{Does the patient live in or has the patient recently traveled to an area with Zika?}
    Q2{Has the patient had unprotected sex with a partner who has lived in or traveled to an area with Zika?}
    A1[NO] --> DNT[Do Not Test for Zika]
    A2[YES] --> T[Zika]
    A3[NO] --> DNT
    A4[YES] --> T
    Q1 --> A1
    Q1 --> A2
    Q2 --> A3
    Q2 --> A4
    T --> T
    DNT --> DNT
```


Do Not Test for Zika

Test for Zika

*Healthcare providers should review their local and state health jurisdiction guidelines regarding testing of patients with clinically compatible illness without known travel or sexual exposures.

CDC does not recommend Zika virus testing for asymptomatic

- Men
- Children
- Women who are not pregnant



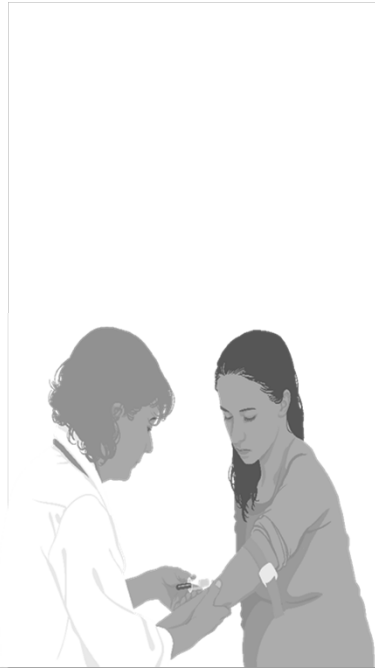
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

CDC04720A August 17, 2016

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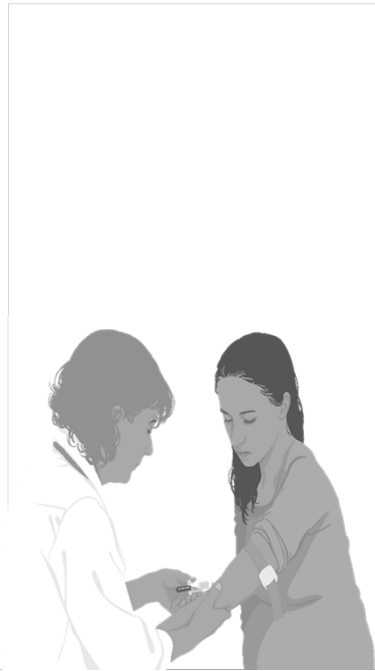
How is Zika diagnosed?

- A doctor or other healthcare provider will ask about any recent travel and any signs and symptoms.
- A blood or urine test can confirm a Zika infection.



Who should be tested for Zika?

- Anyone who has or recently had Zika symptoms
 - And lives in or traveled to any area with risk of Zika, or
 - Had unprotected sex with a partner who lives in or traveled to any area with risk of Zika



Who should be tested for Zika?

- All pregnant women (regardless of symptoms) who
 - Live in or recently traveled to an area with risk of Zika that has a CDC Zika travel notice, or
 - Had unprotected sex with a partner who lives in or traveled to an area with risk of Zika that has a CDC Zika travel notice



Who should be tested for Zika?

- Pregnant women who live in or recently traveled to an area with risk of Zika but **without** a CDC Zika travel notice
 - If they develop symptoms of Zika, or
 - If their fetus has abnormalities on an ultrasound that may be related to Zika infection



Testing babies for Zika

CDC recommends laboratory testing for

- All infants born to mothers with laboratory evidence of Zika virus infection during pregnancy
- Infants who have abnormal clinical or neuroimaging findings suggestive of congenital Zika syndrome and a mother with a possible exposure to Zika virus, regardless of maternal Zika virus testing results



Local Challenges with Zika

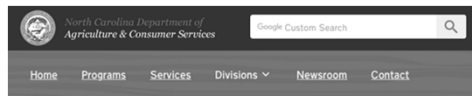
- Media induced fears can lead to over-reaction.
- Defining area of transmission risk is arbitrary.
- Right of entry can be challenged.

Local Challenges with Zika

- Board of Health has authority and jurisdiction but can they act in a timely manner?
- Bee Keepers and pesticide opponents.
- Sexual transmission difficult to monitor and even more difficult to enforce control measures.

130A-17. Right of entry.

(a) The Secretary and a local health director shall have the right of entry upon the premises of any place where entry is necessary to enforce the provisions of this Chapter or the rules adopted by the Commission or a local board of health. If consent for entry is not obtained, an administrative search and inspection warrant shall be obtained pursuant to G.S. 15-27.2. However, if an imminent hazard exists, no warrant is required for entry upon the premises.



Pesticides Section

Licensing & Certification

- | | |
|--|---|
| <p>Applicator Searches</p> <ul style="list-style-type: none"> • Licensee Search / Credit Report • Private Applicator Credits by County • Private Applicator Search | <p>Explanation of Licensing & Certification</p> <ul style="list-style-type: none"> • Certification and Licensing • Pesticide Applicators • Dealers & Consultants • Reciprocity • Licensing Categories |
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2017 Summer Workshop Program

North Carolina Mosquito and Vector Control Association



www.ncmvca.org

July 11-12, 2017
 Pitt County Cooperative Extension Center
 403 Government Circle
 Greenville, NC

Thanks for your time, and don't forget, ticks are still here...!

