MOSQUITOES 101

The Basics of Disease Transmission and Control

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How does a mosquito serve as a vector?

- Mosquitoes are small flies *(Order Diptera – the two-winged flies)* with modified mouthparts evolved to suck blood
- A female mosquito seeks a host's blood to help develop her eggs *(females, along with males, also feed on plant fluids)*
- During a mosquito bite, saliva containing an anti-coagulant is injected into the host to facilitate feeding
- Infected mosquitoes can pass pathogens in their saliva

The ability to transfer pathogens directly into the host's bloodstream makes mosquitoes a health threat

The Mosquito Bite

What health threats do mosquitoes pose?

- Worldwide there are over 3,000 mosquito species of which 176 are in the U.S., 63 in N.J., and 46 in Monmouth County
- Virtually every placid type of fresh, brackish, and saltwater habitat has been exploited by one or more species
- There are diurnal, crepuscular, and nocturnal species- effectively an “around the clock” bite risk
- Mosquitoes can transmit more than 2 dozen viruses, malaria (protozoa), elephantiasis (filariasis), and botfly (myiasis)

Without personal protection, exposure to mosquito bites is nearly unavoidable during warm months in temperate climates

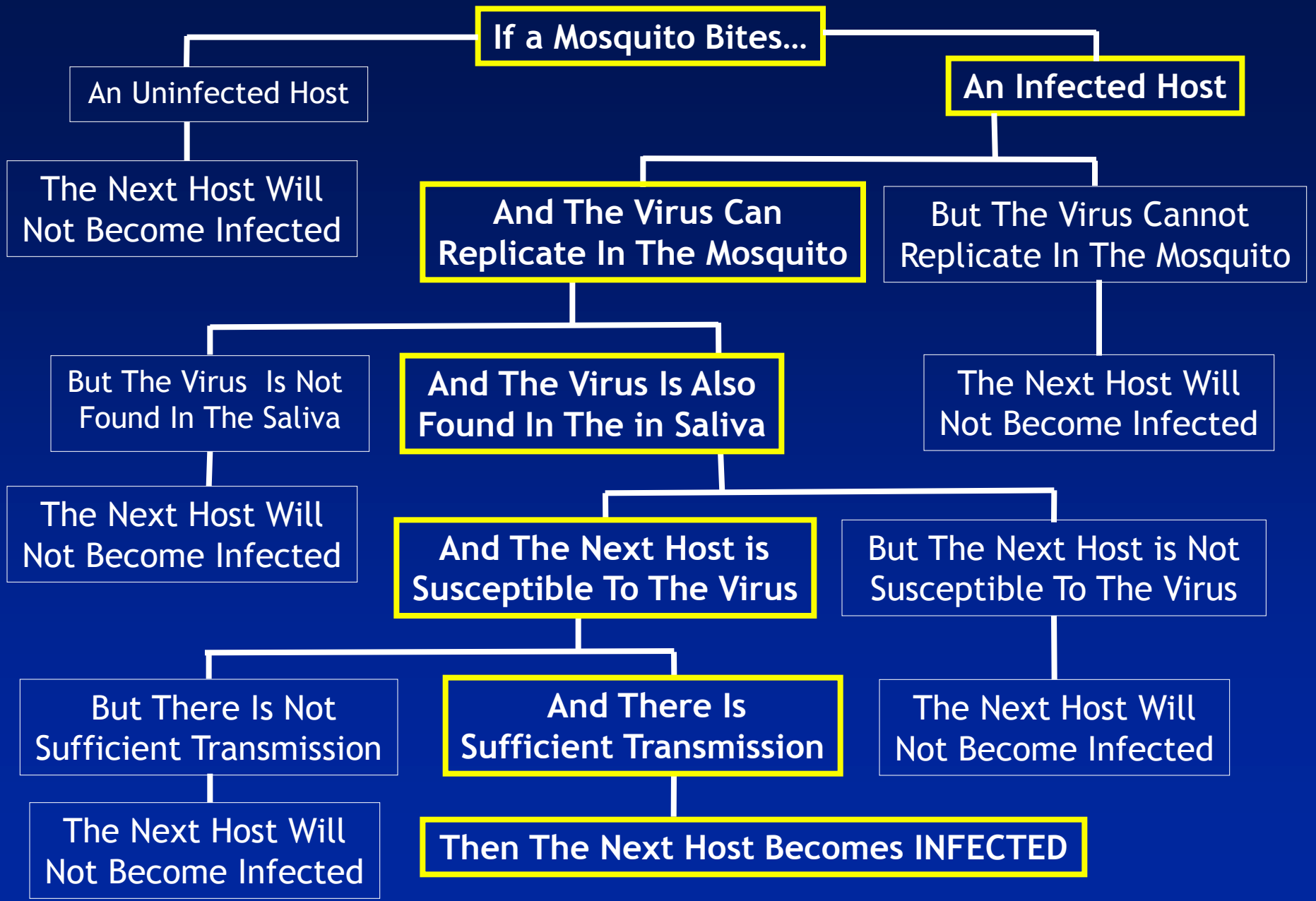
Vector Competence

Some Species Spread Disease More Effectively

- Viruses, mosquitoes, and hosts have co-evolved over millenia
- The genetic compatibility of the mosquito species, pathogen, and host determine the mosquito's suitability as a vector
- Ecological cycles are established but can be fluid regarding geographical range, vector species, host susceptibility, etc.
- Genetic mutations or cultural changes can alter a disease cycle by increasing virulence or exposing new populations

Mosquito control and public health workers need to remain vigilant in monitoring emerging mosquito borne diseases

Vector Competence



Disease transmission

Isolated infections or Outbreaks determined by interactions between

- Pathogen (virus)
- Vector (mosquito)
- Hosts(Humans, birds, animals),
- Weather (dry or wet season, cool nights)
- Geography/climate (range of mosquito species)
- Culture: exposure of hosts to vector (window screens, time spent outdoors)

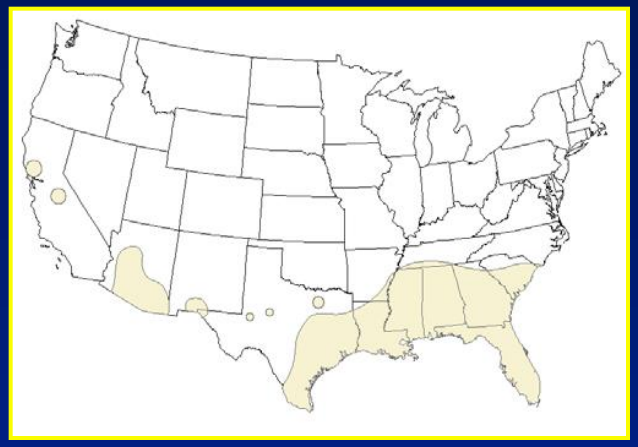
Zika virus vectors

Aedes aegypti – a demonstrated Zika vector

- Aggressive **human biter** preferring the indoors
- Usually breeds in **containers** closely associated with human habitation
- Strongly **vector competent** (YFV, DEN, CHIKV, ZIKV, et al.)
- Introduced tropical species whose range is increasing

Zika virus vectors

Aedes aegypti – a demonstrated Zika vector



Established populations

Estimated range, CDC March 2016

- *Aedes aegypti* has recently been detected as far north as Virginia, Maryland, and D.C.
- There is no population of *Aedes aegypti* in New Jersey currently
- Estimated range based on report of detection in Morris County in 1990
- No record of *Aedes aegypti* in Monmouth County Mosquito Control Division surveillance archives (100+ years)

Zika virus vectors

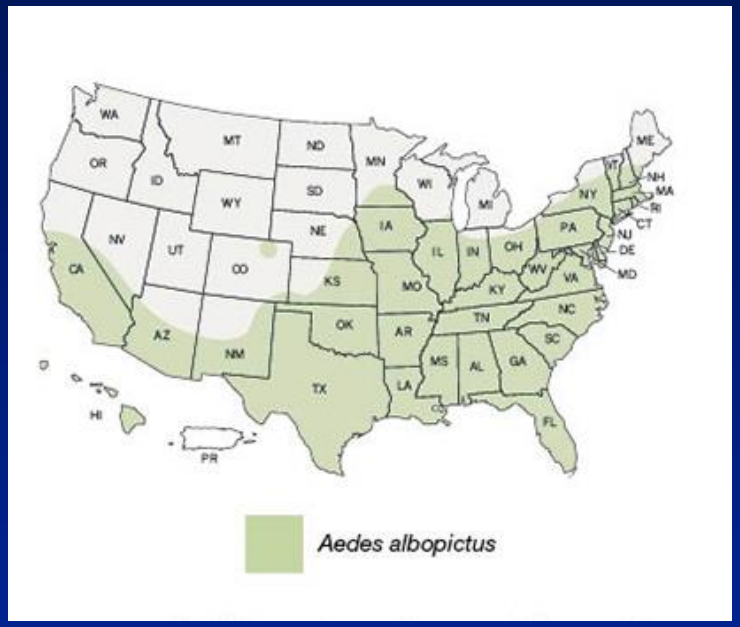
Aedes albopictus – a possible Zika vector

- Aggressive **human biter** primarily outdoors but frequently enters structures
- Utilizes a wide variety of artificial containers *(including very small ones)*
- More laboratory competent than field competent; **implicated** in the transmission of WNV, EEE, DEN, et al.
- Introduced temperate species whose range is expanding

Zika virus vectors

Aedes albopictus – a possible Zika vector

Established populations



Estimated range, CDC March 2016

Aedes albopictus is strongly established in New Jersey and is the primary nuisance species for a majority of counties including Monmouth

Monmouth County Mosquito Control Division Operations

- Surveillance
- Adult Mosquito Control
- Larval Mosquito Control
- Education

Vector Surveillance

Surveillance: Essential for the planning, justification, implementation, and evaluation of a mosquito control program

How MCMCD tracks mosquito borne viruses

- MCMCD monitors mosquitoes for WNV, EEE, DEN, and CHIKV
- Weekly live-trapping of adult mosquitoes is conducted from early May through October
- In 2015, MCMCD tested 966 mosquito samples for virus (*a N.J. state record*)

Vector Surveillance

CDC Miniature Light Trap

- Uses dry ice as an attractant
- Simulates animal exhalation
- Mosquitoes follow the concentration gradient
- Tends to attract mammal biting species including human biters

CDC Gravid Trap

- Uses grass infusion as an attractant
- Simulates a stagnant water site
- Pregnant (gravid) mosquitoes attempt to lay eggs
- Tends to attract bird-biting species

Vector Surveillance

BGS Sentinel Trap

- Uses proprietary lure
- Simulates human sweat/body odor
- Strong black and white contrast is also an attractant
- Tends to attract *Aedes albopictus* (a.k.a. the Asian tiger mosquito)

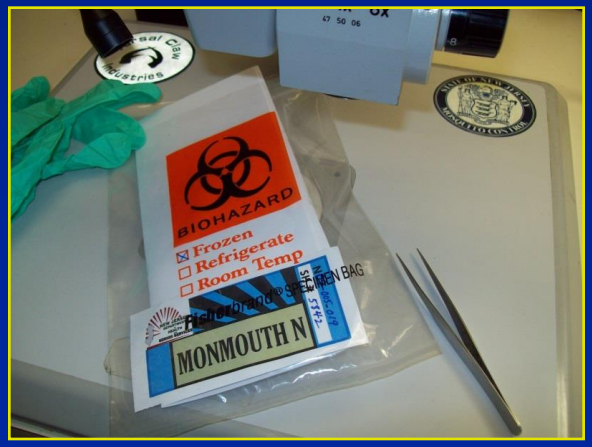
Resting Boxes

- One cubic foot plywood box
- Black exterior with red interior serves as an attractant
- Nocturnal mosquitoes come to rest for the daytime hours
- Tends to particularly attract the vector of EEE (*Culiseta melanura*)

Vector Surveillance

NJDOH Virus Testing

- Sponsored by the N.J. OMCC
- Uses high-throughput RT-PCR automated Taq-Man system
- Can test for WNV, EEE, SLE, LAC, DEN, and CHIKV
- If NJDOH expands testing mosquitoes for Zika virus, the MCMCD will participate



RAMP Virus Testing

- Can test for WNV and DEN
- Gives quantitative results
- Tests are conducted at the MCMCD lab in Tinton Falls
- Provides fast data to supplement NJDOH testing

Our Response to Positive Results

Adult Mosquito Control initiated

- ASAP after notification of human case
- With positive mosquito pool of bridge vector/aggressive mammal biters
- With multiple mosquito pools of *Culex* mosquitoes
- Repeated with continued collection of any positive mosquito pools after treatment (depending on season/weather)

Additional actions

- Expanded trapping of adult mosquitoes for further testing
- Increased larviciding and inspections within the treatment zones or West Nile virus evidence is found
- Increased educational efforts for sanitation and personal protection

Rapid Response to Positive Test Results

Adult Mosquito Control

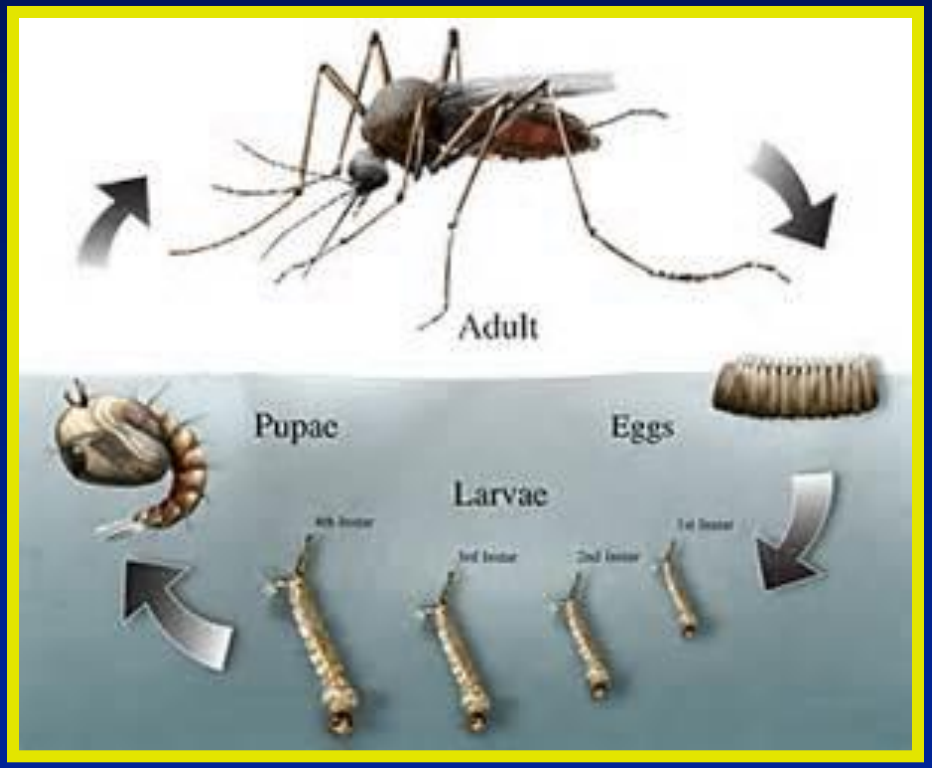
- In Monmouth County, control of flying adult mosquitoes is conducted in response to elevated risk of disease transmission
- Purpose is to knock done numbers of mosquitoes and break transmission cycle
- Done on a communitywide basis using Ultra-low volume application equipment mounted on pick-up trucks
- Treatment area determined by mosquito population data, mosquito habitats, human population density, natural and man-made boundaries (flood plains, wide roads, etc.) vectors usually weak fliers.
- Balance between anti-pesticide and spray the whole county sentiments. When we get concerns from both sides, we've done well.

Adult Mosquito Control

- Public Notice- Display ad in Asbury Park Press, legal ad in Star ledger every three weeks
- Prior to operation, notify health officers, municipal administrators, and County officials
- Notify citizens on notification or “no-spray” list
- Contact beekeepers within 3 miles
- Post maps and description of treatment zones on website and on Division hot-line
- Issue press release (County PIO)
- Municipalities initiate reverse 911 where available

- Operations conducted dawn, dusk or late night
- Police Departments notified directly before start and end of operation
- ULV application equipment mounted on pick-up trucks, usually 2 trucks with 2 staff per area
- Weather conditions monitored in office and field
- Cool nights limit mosquito activity
- Pesticide applications limited by wind and temperature (<10 mph, >50 F)

The Mosquito Life Cycle



The cycle takes about 1 WEEK for most species

Mosquito Control Operations

Larval Mosquito Habitat Inspection and Control

- Each Request for Service (avg. of **741**/season) and every catalogued site (**3,500** for the county) is thoroughly examined for evidence of larvae and/or pupae and for adults “on-the-wing”

- Aerial application of granular larvicide on large tracts of standing water such as saltmarshes and forested wetlands and floodplains

Mosquito Control Operations

An Integrated Pest Management Approach

Biological Control

- We use predacious fish to consume the aquatic stages of mosquitoes in sites that do not already contain fish
- The program is overseen by the N.J. Office of Mosquito Control Coordination and is regulated by the N.J. DEP
- Allows for season(s)-long control without pesticides
- Not suitable for every site

Mosquito Control Operations

An Integrated Pest Management Approach

Physical Control: Sanitation

Mosquito Control Operations

An Integrated Pest Management Approach

Cultural: outreach and education

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The Basics of Disease Transmission and Control

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Thank You