

## West Nile Virus (WNV) in Barbados



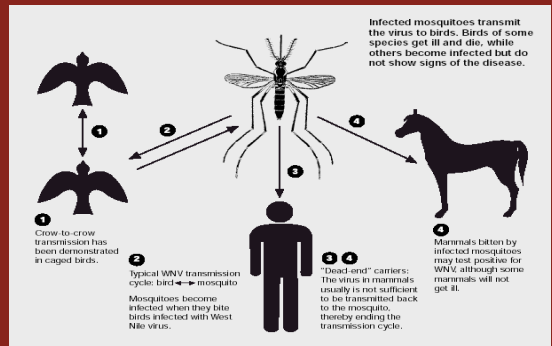
## History of West Nile Virus (WNV)

- In 1937, WNV first isolated from a febrile woman in the West Nile District of Uganda
- Negative strand RNA virus of the family Flaviviridae
- In 1957, WNV outbreak in Israel
- Early 1960s, WNV noted in horses in Egypt and France
- In 1999, WNV first seen in North America

## West Nile Virus (WNV)

- West Nile, a flaviviral disease, is currently endemic in United States.
- Southern spread to the Caribbean possibly via migratory birds.
- WNV detected in Jamaica, Puerto Rico, Santo Domingo, Guadeloupe and Trinidad.

## West Nile Virus Transmission Cycle



## West Nile Fever

- Incubation is 3-15 days
- Symptoms: fever, headache, backache, myalgia, nausea, vomiting diarrhea, rash, muscle weakness, paralysis....weakness and confusion can on for months afterwards
- Encephalitis usually does not present with muscle weakness and paralysis

## WNV surveillance in Barbados

### HUMAN SURVEILLANCE

- **Leptospira Laboratory**, Enmore House, St. Michael, Barbados
- (Dr. Marquita Gittens – Laboratory Director)
- 2 Laboratory technicians
  - Ms. Carol Whittington
  - Ms. Nicole Sandiford
- Fever of unknown origin (FUO) patients.
- Symptoms include-
  - fever, malaise, retro-orbital pain, jaundice, joint pain, rash etc.

## Leptospira Laboratory

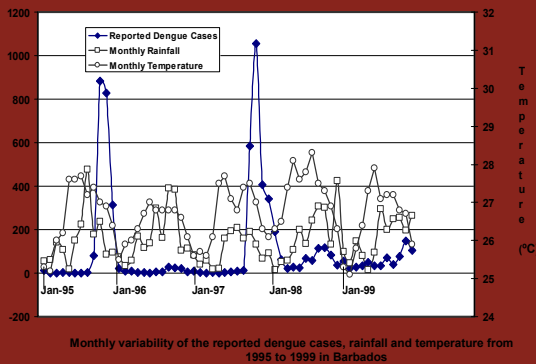
- Spectrum of FUO diagnosis
  - Leptospirosis (MAT, PCR)
  - Dengue Fever (IgM & IgG ELISA, Focus Technologies)
  - Hantavirus (ELISA, Focus Technologies) (Haemorrhagic fever with renal syndrome HFRS)
  - West Nile fever (IgG ELISA, Focus Technologies)

## WNV surveillance in Barbados

### Human surveillance

- Retrospective serostudy in humans (1999-present)  $n = 51$  patients
- Leptospira-negative, dengue-negative, hantavirus-negative patient sera tested.
- No WNV ELISA positive sera (0%, 0/51)

## Dengue, rainfall and temperature



## Barbados' WNV Situation

### Animal surveillance

Veterinary Services Laboratory, Pine Road, St. Michael, Barbados.

- **Contact:** [vetlab@sunbeach.net](mailto:vetlab@sunbeach.net)
- Director/Histopathologist - **Dr. Stephen St.John**
- Laboratory Manager – **Mr. David Elcock**
- 5 Laboratory technicians
  - Ms. Pamela Whitehall – Food microbiology
  - Ms. Brenda Begg – Histology/Mycology
  - Ms. Heather Hall – Clinical pathology/Antibiotic residue
  - Ms. Ronna Watson – Serology/Immunology
  - Ms. Kerrilyn Hunte – Veterinary microbiology

## WNV surveillance in Barbados

### Animal serosurvey

- WNV serosurveillance underway in equines and poultry
- ~ 3,000 horses
- Poultry - ~ 2 million birds in Barbados.
- One serosurvey on a small sample population of equines ( $n = 72$ ) (Dr. Huey).
- Parish of St. Thomas, Barbados.
- 1 out of 72 (1.4%) horses was WNV seropositive by ELISA and PRNT.

## Possible WNV Vectors

**Table 1.** The variety of mosquito species present in Barbados and their characteristics.

Mosquito Species	Habitat	Host Feeding Preference	WNV vector potential
<i>Aedes taeniorhynchus</i> (Wiedemann)	Ground pools, salt marshes	Anthropophilic	Yes
<i>Aedes aegypti</i> (Linnaeus)	Urban areas, artificial containers, tree holes	Anthropophilic	Yes
<i>Aedes albopictus</i>	Urban & Rural, artificial and natural containers	Anthropophilic	Yes
<i>Culex infictus</i> (Theobald)	Small ground pools, crab holes	?	?
<i>Culex negripalpus</i> (Theobald)	Ditches, leaf axils, artificial containers	Mammophilic	Yes
<i>Culex quinquefasciatus</i> (Say)	Polluted water, sewage ponds, fresh water	Ornithophilic & Mammophilic	Yes

## Possible WNV Avian Hosts

**Table 2.** Bird species testing positive for West Nile virus in previous studies and observed in Barbados.

Common Name	Scientific Name	Migratory/resident
Bananaquit	<i>Coereba flaveola</i>	Resident
Antillean grackle	<i>Quiscalus niger</i>	Resident
Common ground dove	<i>Columbina passerina</i>	Resident
Yellow warbler	<i>Dendroica petechia</i>	Migratory
Black-faced grassquit	<i>Tiaris bicolora</i>	Resident
Great Blue Heron	<i>Ardea herodias</i>	Resident
Green Heron	<i>Butorides virescens</i>	Resident
Broad-winged Hawk	<i>Buteo platypterus</i>	Migratory
Ruddy turnstone	<i>Arenaria interpres</i>	Migratory
Sanderling	<i>Calidris alba</i>	Migratory
Rock dove	<i>Columba livia</i>	Resident
Cattle egret	<i>Ibis bubculus</i>	Resident

## WNV modes of entry

How would WNV enter Barbados?

- Three possible modes of entry:
  1. WNV-infected migratory birds
  2. WNV-infected vectors
    - By marine transport
      - (sea containers) adults and larval forms
    - By air transport
      - (airplane cargo hold) adult forms

## Methods

- the terms in parentheses represent the integral of the probability distribution of an bird's viremia on day  $i$ ,  $v_i$ , assuming a normal distribution and variance,  $\sigma^2$ , multiplied by the probability of a bite leading to a disseminated infection in a mosquito,  $I_m$ , (given the host's viremia) and summed over the viremic period  $n$  (in days) for that species

$$\frac{1}{n} \sum_{i=1}^n \sum_{j=i}^n \left( \int_5^{15.3} I_m(v_i) N(v_i, \sigma) dv + \int_{15.3}^{\infty} N(v_i, \sigma) dv \right)$$

## Methods

- Estimation for mosquitoes entering Barbados via air transport as:
- # infected mosquitoes = (total flights per week/city) x (duration of WNV season) x (number of *Culex* mosquitoes aboard each flight) x (*Culex* mosquito WNV infection prevalence) x (vector competence index) x (days infectious)

**Table 3.** Estimated number of WNV-infectious mosquitoes introduced to Barbados via direct flights from North American cities assuming a 22 week WNV season.

Airport Location	# of flights/ week	WNV prevalence	# WNV-infectious mosquitoes/year
Toronto, ON	8	0.0034	0.20
New York, NY	19		0.48
Newark, NJ	1		0.03
Philadelphia, PA	8		0.20
Washington, D.C	3		0.08
Miami, FL	15	0.0048	0.54
Puerto Rico	13		0.47
Jamaica	7		0.25
<b>TOTAL</b>	<b>74</b>		<b>2.25</b>

**Table 4.** Estimated numbers of WNV-infectious mosquito vectors and avian hosts introduced into Barbados annually.

Mode	# hosts or vectors	Fraction WNV infected	# WNV infectious	# WNV-infectious days
Mosquitoes by air	825*1.55	0.22*(0.0034 or 0.0048)	2.25	23-45
Mosquitoes by boat	16751 x 22/52 x 0.0005	0.0048	0.004	0.04-0.07
Migratory birds	55,500-81,000	15/12,000	69-101	23.7-34.3
Shorebirds	~50-70,000		62.5-87.5	22-31
Ducks	~5-10,000		6.3-12.5	1.7-3.4
Passerines	~500-1000		0.6-1.3	0.2-0.4

## Conclusions

- Suspected WNV circulation in Barbados in animals namely equines.
- No WNV human cases to date.
- High risk of WNV entry
  - infected vectors transported by air
  - WNV infected migrating birds.

## Possible solutions/asures

- Spraying cargo holds of aircraft.
- Conducting surveillance of WNV vectors & birds in specified areas.
  - Types
  - Population sizes
- Targetting vector reduction efforts e.g. fogging in these areas.