Mosquitoes and Zika Virus: Assessing the Threat

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Origins of Zika Virus

- Zika virus discovered in Kampala, Uganda in 1947
  - Isolated from monkeys and mosquitoes
- First human case identified in Nigeria, Africa in 1954
- Zika virus documented in other African and Asian countries (1951-1981)
- Considered a rare and benign disease
  - <20 documented human cases
  - Fever and rash
Zika Virus Spreads to the Pacific Islands

• Large outbreak on Yap Island, Micronesia in 2007
  • 75% of residents infected

• Virus spreads to more Pacific Islands
  • French Polynesia 2013
    • 30,000 human cases
    • Neurological complications in small percentage of cases

• New Caledonia, Cook Island, and Easter Island 2014

• Vanuatu, Solomon Islands, Samoa, and Fiji 2015
Zika Virus Epidemic in Brazil

• First documented cases in the Western Hemisphere in May 2015
• Epicenter in Recife Brazil
• Virus was most similar to strains circulating in the French Polynesia in 2013
• More than 20-fold rise of newborns born with microcephaly during the past year
• Estimated 1.5 million cases
Zika Virus Spread in the Americas

- Virus spreads throughout Latin America and the Caribbean 2015-present
- Active transmission documented in 41 countries or territories.
- Zika virus infection documented in travelers returning to the U.S.
Zika Virus Transmission Modes

- Infectious mosquito bites
  - Vast majority of Zika infections acquired by mosquito bite
- Congenital infection by infected mothers
  - Virus crosses the placenta to infect the fetus
  - Microcephaly when virus attacks fetal nerve cells
- Blood transfusion from asymptomatic Zika infected blood donors
- Sexual transmission of Zika virus
  - Primarily by infected men to their partners
Mosquito vectors

Yellow fever mosquito
(Aedes aegypti)

Asian Tiger Mosquito
(Aedes albopictus)
**Aedes aegypti**

- Primary urban vector of Dengue, Yellow Fever, Chikungunya, and Zika viruses
- Originated from sub-Saharan Africa
- Introduced into the Americas during the trans-Atlantic Slave trade during 15-17th centuries
- Currently has global distribution in tropical and subtropical regions
- Closely Associated with Humans
  - Eggs and larvae develop in artificial containers
  - Adults rest inside houses
  - Feed frequently and almost exclusively on human blood
Distribution of *Aedes aegypti* in the U.S.

*Extreme Range*

*Normal Range*

*Darsie & Ward 2005*
**Aedes albopictus**

- Most invasive mosquito in the world
- Native to SE Asia, has spread to > 50 countries over last 3 decades
  - Introduced into the U.S. in 1985
- Spread primarily in used tires and “lucky bamboo” plants
- Tolerates colder temperatures compared to *Aedes aegypti*
- Diverse habitats- rural, suburban, urban
- Breeds in artificial containers and tree holes
- Human biter but also feeds on other domestic and wild animals
Distribution of *Aedes albopictus* in the U.S.
Distribution of the Asian Tiger Mosquito *Aedes albopictus* in Connecticut

- **2006**  
  - N = 1

- **2010**  
  - N = 2

- **2011**  
  - N = 12

- **2012**  
  - N = 245

- **2013**  
  - N = 547

- **2014**  
  - N = 133

- **2015**  
  - N = 220
Connecticut Mosquito Monitoring Program

- Mosquito trapping June-October
- 91 trapping stations
  - Two types of mosquito traps- light and gravid traps
- Mosquitoes sorted and identified to species level
  - 50 mosquito species in CT
- Mosquitoes tested for virus infection in high-containment BSL-3 lab
- Information on virus-infected mosquitoes:
  - Early warning system
  - Assess risk of human infection
  - Guide mosquito control and disease prevention efforts
Enhanced Mosquito Surveillance for Zika Virus

- Added BG Sentinel Traps
  - Placed in locations with appropriate habitat
- Designed for *Ae. albopictus*
  - Used at sites to evaluate population size
  - Baited with Human Scent Lure
- All mosquitoes tested for Zika virus in addition to EEE and West Nile viruses
Zika Virus: Assessing the Threat

The virus is spreading uncontrolled in the Latin America and the Caribbean.

Will likely spread throughout the Americas wherever *Ae. aegypti* occurs similar to Dengue and Chikungunya viruses.

Most of the population is naïve, setting the stage for major epidemics: hundreds of millions of people at risk.

There could be potential for the virus to establish an enzootic monkey – human cycle as occurred with Yellow Fever.

No vaccine is currently available.

Prospects for control in Latin and South America are not good!
Zika Virus: Assessing the Threat in the U.S.

Most mosquito-mediated transmission in the U.S. will likely occur via *Ae. aegypti* which should limit geographic spread.

The capacity for *Ae. albopictus* to transmit Zika virus provides potential for local transmission in the continental US where *Ae. albopictus* is common.

Don’t know what role *Ae. albopictus* will play in spreading the virus in more temperate regions.

The ability of other U.S. mosquito species to transmit virus is unknown.
Travel associated human cases of Zika virus July 20, 2016

Aedes aegypti
normal range

Aedes aegypti
extreme range

Recent local dengue
chikungunya
transmission
Questions?

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