

1 Arboviruses

Arboviruses (arthropod-borne viruses) exist in many families of viruses

There are > 500 recognized arboviruses worldwide

150 are known to cause human disease

Mosquitos kill the most people per year of any animal

1.1 Common Types of Mosquitoes

There are over 3000 mosquito species

The most dangerous mosquitoes are certain species of Anopheles, Aedes, and Culex

Culex Mosquitoes — West Nile Virus, Western Equine Encephalitis, Eastern Equine encephalitis

Anopheles Mosquitoes — Malaria

Aedes Mosquitoes — Zika, Chikungunya, Yellow Fever, Dengue

1.2 Mosquito Anatomy and Feeding

Only female mosquitoes bite

Most female mosquitoes must blood-feed on a vertebrate host to produce eggs

1. Female mosquito mouthparts form a long, piercing proboscis
2. Males have feathery antennae and a proboscis not suited to piercing skin
3. Both genders usually feed on nectar
4. While taking blood, the female injects saliva in the host which serve as an anticoagulant
also induces an inflammatory response

1.2.1 Viral Transmission

The virus circulates and multiplies in the mosquito's hemolymph (blood) for several days

The virus then penetrates and infects the mosquito's salivary glands

After an incubation period of 1-2 weeks, the infected mosquito can transmit viruses to humans and animals while taking blood meals

1.2.2 Role of Mosquito Saliva in Arbovirus Transmission

Mice inoculated with West Nile Virus mixed with mosquito salivary gland extract had enhanced viremia compared to those inoculated without the salivary gland extract

1.3 Arbovirus Transmission

1. In general, the arthropod host has no apparent disease
2. Infection persists for life in the arthropod vector
3. Virus can be transmitted transovarially to vector progeny
4. Birds, rodents, and reptiles can be reservoir hosts
5. Mammals can be 'dead end hosts'

Ex: Humans, horses

6. Humans can be the primary vertebrate host for:

Chikungunya, Dengue, Yellow Fever, Zika

2 West Nile Virus

2.1 History

1. Isolated from a feverish patient from the West Nile district of Northern Uganda in 1937
2. Several 'large' outbreaks occurred sporadically since the 50s, including epidemics in Russia, Spain, South Africa, etc.
3. WNV is not entirely absent from Asia, but it is generally less significant than in other regions

2.2 Transmission Cycle

Generally between birds through Culex mosquito vector

Dead end hosts include humans and horses

West Nile arrived recently in the US and spread quickly

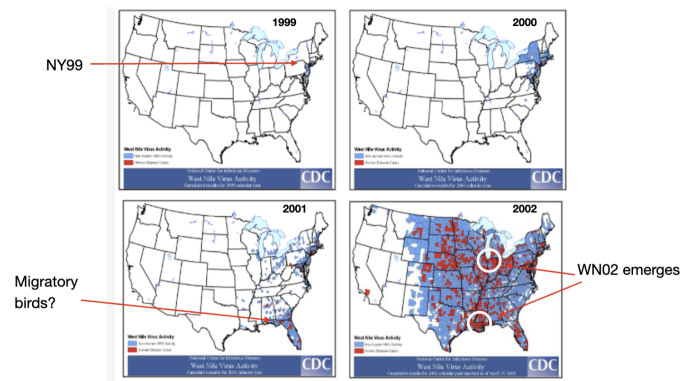


Figure 1: West Nile Virus in the US

Almost all cases occur between June and October (mosquito season)

2.3 Pathogenesis

1. Infection
2. Migration to lymph nodes
3. Migration to spleen (visceral-organ dissemination phase)
4. Crossing the blood-brain barrier
5. Infection of neurons

75% of infections are asymptomatic

25% develop West Nile fever

Less than 1% lead to neuroinvasive disease

2.4 Vaccine

Who is there a WNV vaccine for horses but not for humans?

1. Unpredictable outbreaks (timing, geographic)
2. Economic considerations (market size)
3. Lack of progression to phase 3 trials (enrollment, case counts)
4. Regulatory challenges

2.5 Risk Reduction

Vector management (Educate, Surveillance, Mosquito Control)

Educate: Eliminate standing water

Surveil: Finding and monitoring places where adult mosquitoes lay eggs

Tracking the viruses mosquito populations may be carrying

Allow chickens to be bitten by mosquitoes and check immune response

Mosquito Control: Mosquitofish live in ponds and eat mosquito larvae

Use of Mosquito Dunks which is added to standing water and kills larvae

→ Biological larvacide called BTI (*Bacillus thuringiensis* subspecies *israelensis*)

Fumigation if BTI fails