West Nile Virus

Protocol Fit:

- I: ELISA for Tracking Disease Outbreaks
- II: Antigen Detection ELISA
- III: ELISA Antibody Test

Name of pathogen	West Nile virus (WNV)
Type of organism	RNA virus; flavivirus (virus in the family Flaviviridae)
Infectious agent	Virus
Method of spread	Bite from an infected mosquito. Transmission cycle is: 1) mosquito bites infected bird or animal; 2) virus circulates in mosquito's blood; 3) virus enters mosquito's salivary glands; and 4) mosquito injects virus into a human or animal when it bites. No evidence that WNV can be spread person to person or animal to person. Very rarely, transmission via transplanted organs from an infected individual, transmission by transfusion of blood products, or mother-to-child (across the placenta) transmission.
Incubation	3 to 14 days
Symptoms	Most people infected with WNV will have no illness. Approximately 20% of infected people will have West Nile fever with mild symptoms including fever, headache, body aches, skin rash, and swollen lymph glands. Less than 1% of infected people will have West Nile encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord) with severe symptoms including headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis.
Infectivity	Not infectious from person to person.
Diagnosis	Initial diagnosis based on clinical suspicion (flu-like symptoms and presence of the virus in birds in the area). ELISA to detect anti-WNV IgM in serum or cerebrospinal fluid, called MAC-ELISA; IgM is detectable in 90% of cases within 8 days of infection. ELISA for West Nile virus or viral antigens in cerebrospinal fluid, tissue, blood, or other body fluids. ELISA for anti-WNV IgG in serum. Note: ELISA reagents are not available commercially, but may be obtained from the CDC.
Treatment	Supportive treatment only (IV fluids, respiratory support, treatment for secondary infections).
Mortality	Among those hospitalized with severe symptoms, mortality rate ~10% (rate highest among those >70 years old).
History as a pathogen	Isolated in Uganda in 1937; characterized in Egypt in the 1950s. Outbreaks in Africa, West Asia, Europe, and Middle East in the 1990s. First appeared in the United States in 1999. In 2003, human cases were reported in 45 states (up from 10 states in 1999–2001).

Prevention	Avoid mosquito bites by using insect repellent containing DEET (N,N-diethyl-*meta*-toluamide), wearing long-sleeved clothes and long pants treated with insect repellents, staying indoors at peak mosquito biting times (dawn, dusk, and in the early evening), and eliminating standing water sources to reduce the number of places available for mosquitoes to lay their eggs.

Suggested scenarios for the classroom: Epidemiological study. In order to understand the characteristics of the West Nile virus, an emerging disease in the United States, it is important to understand how infectious and how pathogenic the disease is. On one street in your town, there have been two severe cases of WNV. You survey the street and find that three other people report having had flu-like symptoms. To determine the epidemiology of the West Nile virus, you test serum samples from everyone in the neighborhood to see how many have been exposed (you may test for IgM, which indicates recent exposure, or you may test for the viral antigen itself). Once you know how many have been exposed, you can determine how many people actually get sick from WNV. Note: According to the CDC, WNV-IgM can persist in serum for 12 months or longer.

Simulation for detecting West Nile virus.

The table below gives an example of how a diagnostic test to detect West Nile virus in a patient's serum sample can be simulated using protocols I and II.

Tube Description	Tube Color	Actual Tube Contents	Simulated Tube Contents
Student samples	Yellow	1x antigen or 1x PBS	Sample derived from patient's blood
Primary antibody	Green	1x primary antibody	Anti-West Nile virus antibody from mouse
Secondary antibody	Orange	1x secondary antibody	Anti-mouse immunoglobulin antibodies conjugated to HRP
Positive control	Violet	1x antigen	Heat-inactivated viral antigen
Negative control	Blue	1x PBS	West Nile virus-negative human serum

Simulation for detecting antibodies to West Nile virus.

The table below gives an example of how a diagnostic test to detect antibodies to West Nile virus in patient's serum sample can be simulated using protocol III.

Tube Description	Tube Color	Actual Tube Contents	Simulated Tube Contents
Purified antigen	Green	1x antigen	Purified West Nile virus proteins
Student samples	Yellow	1x primary antibody or wash buffer	Serum sample from patient
Secondary antibody	Orange	1x secondary antibody	Anti-human immunoglobulin antibodies conjugated to HRP
Positive control	Violet	1x antigen	Serum from a patient with West Nile virus
Negative control	Blue	1x PBS	West Nile virus-negative human serum