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West Nile Virus and Other Mosquito-Borne Encephalitides, Virginia

Introduction

At publication, the first human case of West Nile Virus (WNV) in 2001 has just been identified in a Florida resident with illness onset July 15. Infected birds have been identified in the District of Columbia (1) and the following states: Connecticut (4), Florida (21), Georgia (2), Maryland (51), Massachusetts (6), New Jersey (37), New York (16), Rhode Island (3), and Virginia (1). In addition, 38 positive mosquito pools have been confirmed in Connecticut, Maryland, New Jersey, and New York. (A pool is 25 to 50 mosquitoes of the same species collected at the same time and place.) Equine surveillance has identified three horses with neurologic disease due to WNV infection in Florida. For updated information see the USGS website (cindi.usgs.gov/hazard/event/west_nile/west_nile.html).

WNV encephalitis is one of several mosquito-borne encephalitides that could affect Virginians this year. Eastern equine encephalitis (EEE), Saint Louis encephalitis (SLE), and LaCrosse encephalitis (LAC) have all been reported in Virginia in the past, and their vectors are indigenous. In addition to transmission by mosquitoes, these four diseases have the following in common: clinical features range from febrile headache to aseptic meningitis to encephalitis; routine laboratory test results and central nervous system imaging results are non-specific; and diagnosis depends on serology, virus isolation, or antigen detection from cerebrospinal fluid (CSF) or brain tissue. Treatment involves supportive care; controlled trials of antivirals have not been conducted. Disease outcomes range from full recovery to long-term sequelae or death.

As seen in Table 1, the diseases vary in the ratio of inapparent to apparent infections, age of persons who are most commonly affected, and case fatality rates. The distribution, ecologic niches and transmission patterns also vary (Table 2).

Human Arboviral Disease, Virginia

Eastern Equine Encephalitis
Tidewater area - 1975 (2), 1998 (1); Henrico - 1990 (1)
St. Louis Encephalitis
Richmond area - 1976 (4)
LaCrosse Encephalitis
Southwest Virginia - 0-7 cases yearly since 1994

West Nile Virus

First identified in 1937 from the blood of a febrile Ugandan woman, WNV has been associated with at least 8 outbreaks in 7 countries since 1951, in addition to the US experience. This will be the third season for WNV in the western hemisphere.

In 1999, WNV activity was centered in Queens in New York City. That year, 59 humans with serious disease were identified, 7 of whom died. The median age was 71 years (range 5-90 years) and onset dates ranged from August to September. A serosurvey conducted in the affected Queens neighborhood revealed that 2.6% of the population had been infected, but had no or mild symptoms. In addition, 25 horses and 1 cat were diagnosed with the disease. Although thousands of birds were believed to have died from WNV, only 194 were diagnosed with the disease, probably because avian surveillance began late. The geographic distribution of WNV-positive mosquitoes correlated with the human cases, and positive mosquitoes were found over-wintering in underground areas of Queens.

In 2000, the virus was found in >4,300 birds in 11 states from New Hampshire to North Carolina. Every county except one in New York reported at least one positive bird. Infected mammals included 59 horses, 2 bats, and 1 each rabbit, squirrel, chipmunk and skunk. Increased surveillance and testing of mosquitoes resulted in 480 positive pools from five states. Despite this dramatic geographic expansion of the virus, human cases were fewer than the previous year with 20 seriously ill and 2 deaths. The median age was 63 years (range 36-87 years) and onset dates ranged from mid-July to early October. The area with the most human illness was Staten Island, New York with 10 cases. Other cases were reported from Brooklyn (2), Manhattan (1), Queens (1), and New Jersey (6). The clinical and laboratory findings for hospitalized patients are presented in Table 3. A seroprevalence study conducted in Staten Island revealed that approximately 0.4% of people tested had antibodies to WNV. Many arboviral experts believe that the human disease burden was reduced by early season efforts to control mosquitoes and by the use of personal protective measures by citizens.

Table 1. Characteristics of Arboviral Encephalitides, United States				
Virus/ Disease	Ratio of inapparent:apparent infections	Age(s) most commonly affected clinically	Sex distribution of cases	Case fatality rate
LAC	100 - 1,000 : 1	<15	60% M	Rare
SLE	200 - 300 : 1	>50	Slight F>M	5 - 15%
EEE	25 : 1	<15 and >55	Slight M>F	30 - 70%
WNV	100 - 150 : 1	>50	50% M	3 - 15%

Many mosquitoes may be capable of transmitting WNV including *Culex pipiens*, a common pest in Virginia which breeds in storm sewer catch basins, containers, gutters, birdbaths, and discarded tires. The risk of encountering an infected mosquito depends on many factors and varies with the local mosquito infection rate and whether the infected mosquito species are prone to biting humans. It is estimated that 1 of 300 people bitten by an infected mosquito will develop symptoms. Of those, 1:100-150 will become seriously ill and about 11% of the seriously ill will die. Serious illness and death most often occur in people >50 years old.

In most instances WNV activity in a community is first identified in wild birds, especially crows and blue jays, which appear more likely than other bird species to develop illness and die from the infection. The normal transmission cycle is bird to bird, passed via the bite of infected mosquitoes. Mammals (especially horses and humans) may become infected if bitten by mosquitoes that feed on both birds and mammals.

LaCrosse Encephalitis

LaCrosse, one of the California serogroup viral encephalitides, is the most frequently reported human arboviral encephalitis in the United States. Virginia cases usually occur in the southwest region. It is probably under-recognized and under-reported in that area; neighboring states of Kentucky, North Carolina and West Virginia consistently report more cases than Virginia. Last year, West Virginia reported 40 cases compared to one unconfirmed case from Virginia. Unlike EEE and WNV, LAC is primarily a disease of children, especially boys 5-10 years of age.

The LAC mild clinical syndrome has a prodrome of several days with low grade fever, headache, malaise, and gastrointestinal symptoms, especially vomiting. The prodrome is followed by a higher fever, lethargy and signs of meningeal irritation which resolves within a week or longer without sequelae. LAC also has a severe clinical syndrome that occurs in about half of the patients. This syndrome starts with high fever, headache and vomiting followed shortly by lethargy and disorientation. It can progress rapidly to seizures (60%), focal neurologic signs (20%), pathologic reflexes (10%), and coma (10%).

LAC is transmitted by *Aedes triseriatus* mosquitoes that breed in tree holes and artificial containers. Transovarial transmission of the virus allows for over-wintering in mosquito eggs.

Saint Louis Encephalitis

Although cases of SLE have not been reported in Virginia since 1976, the potential is always present. Mosquitoes in the *Culex pipiens-quinquefasciatus* complex are common in Virginia and are the major vectors for SLE in the Eastern US. They breed in artificial containers, ditches and polluted water.

Eastern Equine Encephalitis

Although human cases of EEE are not common in the US (about 5 per year), EEE poses the most concern because of the severity of disease and risk of poor outcome. EEE can affect the brainstem and cause respiratory paralysis. Severe cases often have serious sequelae. Patients may require institutionalization and need millions of dollars of care over their lifetime.

EEE is maintained in birds and probably spread from bird to bird by the *Culiseta melanura* mosquito. Throughout the warm months the virus is amplified in this bird/mosquito cycle. The virus is transmitted to humans and horses from infected birds by up to a dozen species of mosquitoes that act as bridge vectors from birds to mammals.

Table 2. Arboviral Encephalitides, United States			
Virus/ Disease	Distribution in U.S.	Most commonly affected areas	Disease Activity Level
LAC	Eastern half	Suburban/rural	Endemic
SLE	Throughout U.S., no geographical pattern	Rural (West), Urban (Central), Suburban/rural (Florida)	Sporadic cases/ outbreaks
EEE	Eastern half	Rural, coastal regions	Sporadic cases/ outbreaks
WNV	East coast (to date)	Urban (to date)	Outbreaks (to date)

Virginia Arboviral Surveillance in 2000

Eleven hundred birds were tested in 2000. Seven crows positive for WNV were found between September 8 and October 20 (one each in Prince Edward, Spotsylvania, Alexandria, Hampton, Hanover, Powhatan, and Fairfax) and 1 EEE-positive sparrow was found in Norfolk. Four EEE-positive mosquito pools were identified of 3,431 tested. Of 1,000 serologic tests done on sentinel chickens, 7 were positive for EEE. Nine of 14 horses tested for EEE were positive. One probable case of LAC was diagnosed of 31 persons tested.

Virginia Arboviral Surveillance in 2001

Humans

Human surveillance is dependent on active involvement from the medical community. **We are requesting that persons hospitalized with clinical evidence of viral encephalitis be reported immediately to the local health department.** The health department will advise on specimen collection and submission. (See page insert for testing criteria.)

The state laboratory, the Division of Consolidated Laboratory Services (DCLS), can detect antibody to WNV, SLE, EEE and LAC in human serum and CSF using IgM antibody capture-ELISA and/or IgG ELISA. The former is the most sensitive screening test for WNV. WNV-positive specimens will be forwarded to the Centers for Disease Control and Prevention for confirmation by Plaque Reduction Neutralization Testing.

Serologic testing for WNV is not necessary for persons with mild or no symptoms. Such persons are unlikely to be infected and even if they are infected will most likely recover completely. Persons with more severe symptoms such as confusion, lethargy, muscle weakness, severe headache, stiff neck, or photophobia should seek medical care and testing for arboviral infections should be considered.

Animals

Wild bird testing continued throughout the winter. In addition to facilitating the submission of crows, jays and raptors (birds of prey such as hawks, falcons, eagles and owls) for WNV testing, local health departments are receiving reports of dead wild bird sightings. This information is entered into a database that is linked to laboratory results. Summary data are updated on the Virginia Department of Health (VDH) website (vdh.state.va.us/epi/wnv.htm) each Tuesday. The number of dead bird sightings will be evaluated to see if an increase in dead birds can be used as a predictor of WNV activity in an area. WNV testing of birds is conducted by the state laboratory, DCLS.

Sentinel chicken flocks are located in Hampton Roads. Serologic tests are performed for EEE, SLE and WNV. Expansion of sentinel chicken flocks for WNV surveillance was not encouraged because last year such flocks were of little benefit in predicting WNV activity in the northeastern US. Flocks seroconverted late in the season, often after horse cases were already identified.

Mosquito surveillance has expanded beyond the traditional Hampton Roads area to a number of new locations. In addition to local efforts, Dr. David Gaines, public health entomologist for VDH, has hired two seasonal mosquito biologists to survey high-risk areas and respond to emergencies. Mosquito habitats are being identified and evaluated for the burden and type of mosquitoes present. Adult mosquitoes are being identified and pools of appropriate species are being submitted to the Norfolk Department of Health Laboratory for arboviral testing.

Equines with neurologic disease should be reported to the nearest Virginia Department of Agriculture and Consumer Services Regional Animal Health Laboratory (RAHL) so that appropriate specimens can be collected for EEE and WNV testing. Equine brains that are submitted for rabies testing and are negative will be tested for EEE and WNV. Breeders of exotic birds and zookeepers should notify the nearest RAHL of any unusual deaths or disease among their captive birds.

Arboviral Disease Prevention

The prevention of mosquito-borne diseases depends on reducing mosquito populations and preventing exposure to mosquito bites. Citizens and governments have been urged through a widespread public information campaign to reduce mosquito breeding sites in areas where people reside. Standing water should be eliminated or allowed to run freely. Larvicides can be used to kill mosquito larvae. Some areas of Virginia have long-standing mosquito control programs that include truck or aerial spraying for adult mosquitoes. New mosquito control activities should be based on the type of mosquito and the risk of human disease. As much as possible, the results of mosquito surveillance will be used to design the most cost-effective and safe control measures should they become necessary.

For protection against mosquito bites, people should wear loose and light-colored clothing with long sleeves and long pants. Insect repellants should contain no more than 20-30% DEET for adults and <10% for children. Repellants should be used on exposed skin and clothing, but not under clothing and not over cuts, wounds, sunburned or irritated skin.

Submitted by Suzanne R. Jenkins, VMD, MPH, Director, Zoonotic Disease Control.
Portions of this report have been adapted from City Health Information, *May 2001, a publication of the New York City Department of Health.*

Table 3. Clinical and Laboratory Findings Among Hospitalized WNV Cases, U.S., 1999 and 2000

	1999 (N=59)	2000 (N=19)
Clinical syndromes:		
Encephalitis with muscle paresis on neurologic examination	20 (34%)	3 (16%)
Encephalitis without muscle paresis	17 (29%)	8 (42%)
Meningitis	17 (29%)	8 (42%)
Milder illness	5 (8%)	0
Signs and symptoms:		
Fever >37.8°C	53 (90%)	17 (90%)
Weakness (by history)	33 (56%)	8 (42%)
Flaccid paralysis	6 (10%)	1 (5%)
Headache	28 (48%)	11 (58%)
Altered mental status	27 (46%)	11 (58%)
Rash	11 (19%)	3 (16%)
Hospital course and outcome:		
ICU admission	19 (32%)	5 (26%)
Mean hospital stay in days (range)	15 (0-82)	7 (1-72)
Fatal cases (case fatality rate)	7 (12%)	2 (10%)
Laboratory and radiologic findings:		
Mean CSF WBC cells/mm^3 (range)	38 (0-525)	308 (0-1782)
Mean CSF protein mg/dL (range)	104 (38-899)	111 (56-555)
Abnormal MRI (total number obtained; % abnormal)*	5 (16; 31%)	2 (7; 29%)

**Defined as leptomeningeal or periventricular enhancement.*

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, May 2001: State	Regions: NW	N	SW	C	E	Total Cases Reported Statewide, January through May: This Year	Last Year	5 Yr Avg
AIDS	87	6	17	18	12	34	409	342	377
Campylobacteriosis	26	4	7	3	8	4	129	140	172
***E. coli* O157:H7**	6	1	4	0	1	0	12	12	10
Giardiasis	24	2	8	5	7	2	147	157	140
Gonorrhea	800	21	37	105	217	420	3717	4052	3555
Hepatitis A	10	4	2	1	0	3	55	63	73
B, acute	11	1	1	3	5	1	54	60	51
C/NANB, acute	0	0	0	0	0	0	0	1	5
HIV Infection	107	7	26	13	26	35	366	313	350
Lead in Children†	58	3	12	6	23	14	217	161	194
Legionellosis	2	0	0	1	1	0	6	3	8
Lyme Disease	20	2	15	0	0	3	27	18	9
Measles	0	0	0	0	0	0	0	0	1
Meningococcal Infection	1	0	1	0	0	0	21	28	26
Mumps	0	0	0	0	0	0	2	4	5
Pertussis	2	0	0	0	0	2	10	16	12
Rabies in Animals	42	7	11	8	5	11	168	249	239
Rocky Mountain Spotted Fever	0	0	0	0	0	0	0	0	1
Rubella	0	0	0	0	0	0	0	0	0
Salmonellosis	80	8	20	17	18	17	388	243	280
Shigellosis	15	2	4	6	0	3	53	66	104
Syphilis, Early§	16	2	0	0	6	8	118	124	231
Tuberculosis	25	2	18	2	2	1	89	115	133

Localities Reporting Animal Rabies This Month: Accomack 1 raccoon; Alexandria 2 bats; Amherst 1 raccoon, 1 skunk; Arlington 1 raccoon; Bedford 2 raccoons; Charlotte 1 raccoon; Chesapeake 1 raccoon; Chesterfield 1 bat, 1 raccoon; Fairfax 1 fox, 2 raccoons; Gloucester 2 raccoons; Goochland 1 raccoon; Halifax 1 raccoon; Hampton 1 raccoon; Henry 1 fox; Highland 1 bobcat; Loudoun 1 bat, 2 raccoons; Prince William 2 raccoons; Pulaski 1 raccoon; Roanoke County 1 raccoon; Rockingham 1 raccoon; Russell 1 fox; Shenandoah 1 groundhog, 1 raccoon; Spotsylvania 1 raccoon; Suffolk 1 raccoon; Virginia Beach 4 raccoons; Warren 1 bat, 1 cat; York 1 raccoon.

Toxic Substance-related Illnesses: Asbestosis 31; Lead Exposure 15; Pneumoconiosis 12.

*Data for 2001 are provisional. †Elevated blood lead levels ≥10µg/dL.

§Includes primary, secondary, and early latent.

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