

## WEST NILE VIRUS

**Introduction.** The introduction and spread of West Nile virus in the United States has reawakened an appreciation of mosquitoes as vectors of diseases. The term "reawakened" is used advisedly, for mosquito-borne diseases were once quite prevalent in the United States and, indeed, played a major part in shaping our nation's destiny. Dengue Fever, long a scourge in the tropics worldwide, was in fact first described by Dr. Benjamin Rush in Philadelphia in 1780. Additionally, Yellow Fever caused over 100,000 deaths in 135 separate epidemics in the United States from 1793 until 1900, and as late as 1934, there were 125,566 cases of malaria. These diseases no longer claim victims in the United States as a matter of course largely due to the exemplary efforts of organized mosquito control agencies, in conjunction with an enlightened and effective public health infrastructure. Indeed, the mosquito control profession enjoys a long and proud legacy of community service in its pursuit of improved quality of life and a society relatively free from the ravages of mosquito-borne diseases that have afflicted our country in times past.

**Background.** The first human isolate of West Nile virus was obtained from woman in the West Nile District of Uganda in 1937, with the transmission dynamics elucidated in Egypt in the mid-1950s. Severe symptoms, including meningitis or encephalitis (inflammation of the spinal cord and brain) was described in elderly patients during an outbreak in Israel in 1957. The ability of WNV to produce severe disease in horses was first noted in Egypt and France shortly thereafter.

Outbreaks of WNV encephalitis in humans noted by CDC "have occurred in Algeria in 1994, Romania in 1996-1997, the Czech Republic in 1997, the Democratic Republic of the Congo in 1998, Russia in 1999, the United States in 1999-2003, and Israel in 2000. Epizootics of disease in horses occurred in Morocco in 1996, Italy in 1998, the United States in 1999-2001, and France in 2000, and in birds in Israel in 1997-2001 and in the United States in 1999-2002."

Since its introduction into the United States in 1999, West Nile virus has spread southward and westward at an alarming pace, with a total of almost 15,700 human cases and 650 fatalities as of 24 September, 2004. Approximately 20% of human West Nile cases develop West Nile Fever, whose symptoms include fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. This condition can last anywhere from a few days up to several weeks. Almost 30% of symptomatic human West Nile cases develop a more severe form of neuroinvasive disease characterized by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis. The neuroinvasive form occurs most often in people over age 50 and some immuno-compromised persons (for example, transplant patients), but can occur at any age in healthy individuals. An in-depth discussion of the disease can be found at the [CDC](#).

As of 1 August 2005, a total of 61 human cases have been reported to the CDC. Of these, 2 have been fatal, 18 exhibited neuroinvasive symptoms, and 40 were classified as West Nile fever. In 2004, a total of 1508 human cases have been reported. Of these, 45 have been fatal, 532 (35%) exhibited neuroinvasive symptoms, and 622 (41%) were classified as West Nile fever. In 2003 a total of 9862 human cases were reported. A total of 264 of these were fatal, 2866 (29%) were diagnosed as neuroinvasive, and 6830 (69%) were classified as West Nile fever. The 2002 outbreak constituted the largest documented outbreak of mosquito-borne meningoencephalitis in the history of the western hemisphere.

The costs these cases entail are extraordinary and extend far beyond medical and vector control expenditures. It has been estimated by CDC that the average cost per patient hospitalized with WNV infection in Louisiana in 2002 was \$51,826, with the total cost of treatment and control exceeding 69 million dollars. However, these numbers fail to address the additional emotional cost to families of victims of mosquito-transmitted disease, a radically-changed quality of life of the victims and similar issues.

West Nile virus has wrought havoc with wildlife as well. More than 200 avian species and 30 mammalian species have been found infected. Although accurate counts of absolute numbers of birds and mammals fatally infected are problematic, the toll for corvids (crows, jays, etc.) is estimated to be in the millions. Horses suffer a 40% mortality rate from infection with this virus. The cost to the horse industry in vaccinations, medical costs, prevention/control measures, and mortality is estimated to exceed one billion dollars.

**Transmission.** Great strides have been made in defining the transmission dynamics of West Nile virus. However, considering that it is a comparatively recent epidemiological phenomenon, there remains much to learn in order to establish and verify baseline data. The cycle involves birds as a reservoir of infection and means of spread through migration, avian-feeding species of mosquitoes amplifying the virus among bird populations, and bridging species of mosquitoes that feed upon both birds and mammals transmitting the virus to humans and equines. At present, 60 of the 174 species of mosquitoes currently recognized in the United States have tested positive for the virus. Of these, generally one species is primarily responsible for transmitting the disease in a particular area. The extent to which other species contribute to the problem is often poorly understood. Each species utilizes preferred aquatic habitats within which to breed. These habitats vary widely, from salt marshes to used car tires. Virtually any collection of stagnant water is fair game, with some species successfully utilizing even soda bottle caps. Factors favoring choice of breeding habitat depend upon the mosquito species involved, topography, climate and human use patterns.