



# WEST NILE VIRUS (WNV)

## INFORMATION AND GUIDANCE FOR CLINICIANS

### West Nile Virus: Epidemiologic Information for Clinicians

#### Infectious Agent

- West Nile virus (WNV) is a single-stranded RNA virus of the family Flaviviridae, genus Flavivirus.
- Flaviviruses share a common size (40-60 nm), symmetry (enveloped, icosahedral nucleocapsid), nucleic acid (positive-sense, single stranded RNA approximately 10,000-11,000 bases), and appearance in the electron microscope.
- WNV is a member of the Japanese encephalitis virus antigenic complex, which includes several medically important viruses associated with human encephalitis: Japanese encephalitis, St. Louis encephalitis, Murray Valley encephalitis, and Kunjin, an Australian subtype of WNV. The close antigenic relationship of the flaviviruses, particularly those belonging to the Japanese encephalitis complex, accounts for the serologic cross-reactions observed in the diagnostic laboratory.
- For unknown reasons, deaths among birds from WNV infection have occurred only in the United States, Israel, Canada, and Mexico.
- Since 1999, very few genetic changes have occurred in the WNV strains circulating in the United States.

#### Hosts/Primary Mode of Transmission

- **WNV is maintained in nature in a transmission cycle that involves primarily birds and mosquitoes** (see [www.cdc.gov/ncidod/dvbid/westnile/cycle.htm](http://www.cdc.gov/ncidod/dvbid/westnile/cycle.htm)).
- **The main route of human infection is through the bite of an infected mosquito.** For more information, see "WNV Entomology" ([www.cdc.gov/ncidod/dvbid/westnile/insects.htm](http://www.cdc.gov/ncidod/dvbid/westnile/insects.htm)).
- **Mosquitoes become infected when they feed on infected birds**, which may circulate the virus in their blood for a few days. Infectious mosquitoes carry virus particles in their salivary glands and infect susceptible bird species during blood-meal feeding. Bird reservoirs will sustain an infectious viremia for 1 to 4 days after exposure after which the hosts that survive develop life-long immunity. For more information, see "WNV: Vertebrate Ecology" ([www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm](http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm)).
- **It is unknown exactly how the virus survives dry seasons in tropical areas or winters in temperate areas.** One proven over-wintering mechanism is in infected adult female *Culex* mosquitoes, which in northern climates hibernate for about six months during the winter.

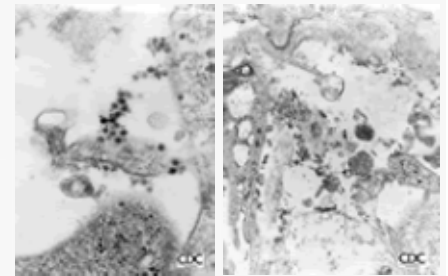


Image A.

Image B.

Scanned images are of West Nile virus isolated from brain tissue from a crow found in New York. The tissue was cultured in a Vero cell for a 3-day incubation period. The Vero cells were fixed in glutaraldehyde, dehydrated, placed in an Epon resin, thin sectioned, placed on a copper grid, and stained with uranyl acetate and lead citrate. The grids were then placed in the electron microscope and viewed.

Total magnifications:  
Image A: 65,625x  
Image B: 171,250x

Image courtesy of Bruce Cropp, Microbiologist, Division of Vector-Borne Infectious Diseases.

## West Nile Virus: Epidemiologic Information for Clinicians

(continued from previous page)

- **People, horses, and most other mammals are not known to commonly develop infectious-level viremias and thus are probably "dead-end" or incidental hosts.** For more information, see "WNV: Vertebrate Ecology" ([www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm](http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm)).
- **Persons should avoid bare-handed contact with dead animals** and use gloves or double plastic bags when collecting bird carcasses (see [www.cdc.gov/ncidod/dvbid/westnile/qa/wnv\\_birds.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/wnv_birds.htm)) for their local health departments or for disposal. (See also "Q & A: WNV and Wild Game/Meat": [www.cdc.gov/ncidod/dvbid/westnile/qa/wnv\\_hunters.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/wnv_hunters.htm).)
- **There is no documented evidence of animal-to-person transmission of WNV apart from mosquitoes.**

For more information on transmission, see "Q & A: WNV Transmission" ([www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm)).

### Alternative Modes of Transmission

Additional routes of transmission to humans other than mosquito bites became apparent during the 2002 epidemic. It is important to note that these other methods of transmission represent a very small proportion of cases.

- **Transplanted organs**—four cases reported in 2002  
For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/transfusion.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/transfusion.htm).
- **Blood transfusions**—a relatively small number of confirmed cases  
For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/transfusion.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/transfusion.htm).
- **Breastmilk**—one probable case reported  
For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/breastfeeding.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/breastfeeding.htm). (See also "WNV Infection and Breastfeeding: Information for Clinicians" [[www.cdc.gov/ncidod/dvbid/westnile/clinician\\_breastfeeding.htm](http://www.cdc.gov/ncidod/dvbid/westnile/clinician_breastfeeding.htm)].)
- **Transplacental (mother-to-child)**  
For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/breastfeeding.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/breastfeeding.htm). (See also the case description in the MMWR [[www.cdc.gov/mmwr/preview/mmwrhtml/mm5150a3.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5150a3.htm)], the WNV Pregnancy Registry [[www.cdc.gov/ncidod/dvbid/westnile/duringpregnancy/wnv\\_duringpregnancy.htm](http://www.cdc.gov/ncidod/dvbid/westnile/duringpregnancy/wnv_duringpregnancy.htm)], and "Interim Guidelines for Evaluation of Infants Born to Mothers Infected With WNV During Pregnancy" [[www.cdc.gov/ncidod/dvbid/westnile/congenitalinterimguidelines.htm](http://www.cdc.gov/ncidod/dvbid/westnile/congenitalinterimguidelines.htm)].)
- **Occupational exposure**—two cases in laboratory workers reported in 2002  
For more information, see [www.cdc.gov/mmwr/preview/mmwrhtml/mm5150a2.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5150a2.htm).

For more information on alternative modes of transmission, see "Q & A: WNV Transmission" ([www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm)) and the slide presentation "West Nile Virus: New modes of transmission" ([www.cdc.gov/ncidod/dvbid/westnile/conf/ppt/marfin\\_new%20modes\\_4th03.ppt](http://www.cdc.gov/ncidod/dvbid/westnile/conf/ppt/marfin_new%20modes_4th03.ppt)).

## West Nile Virus: Epidemiologic Information for Clinicians

(continued from previous page)

### Risk Factors

Age is by far the most important risk factor for developing neuroinvasive WNV infection.

**Table. Median age (in years) of development of West Nile illness following infection**

Year*	Fever	Meningitis	Encephalitis (with or without associated meningitis)	Death**
2002	49	46	64	78
2003	45	46	62	80

\*For data from 2004, see "Statistics, Surveillance, and Control" ([www.cdc.gov/ncidod/dvbid/westnile/surv&control04maps.htm](http://www.cdc.gov/ncidod/dvbid/westnile/surv&control04maps.htm)).

\*\*Most deaths were among encephalitis patients.

It is likely that the viral doses delivered by a mosquito are somewhat similar across these age groups. However, something associated with older age results in a higher risk for development of more serious central nervous system (CNS) disease.

### Disease in Animals

- **Birds**—Between 1999 and 2003, WNV was detected in dead birds of more than 200 species (see [www.cdc.gov/ncidod/dvbid/westnile/birdspecies.htm](http://www.cdc.gov/ncidod/dvbid/westnile/birdspecies.htm)). Although birds, particularly crows and jays, can become ill or die if infected with the virus, most survive. (For more information, see [www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm](http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm).)
- **Dogs and cats**—Because WNV is transmitted by infectious mosquitoes, dogs or cats can be infected with the virus in the same way as humans. (For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/wnv\\_dogs\\_cats.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/wnv_dogs_cats.htm).)
- **Horses**—Cases of WNV disease in horses have been documented, either by virus isolation or by detection of antibodies. Approximately 40% of equine West Nile encephalitis cases result in the death of the horse. Horses become infected with the virus by the bite of infectious mosquitoes. A licensed vaccine is available from veterinarians for equines. (For more information, see [www.cdc.gov/ncidod/dvbid/westnile/qa/wnv\\_horses.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/wnv_horses.htm).)
- **Other mammals such as bats, chipmunks, skunks, squirrels, rabbits, and llamas**—WNV infection has been reported infrequently in these mammals.

Veterinarians should take normal infection control precautions when caring for an animal suspected of having WNV or any viral infection. It may be possible that dogs and cats could become infected by eating infected animals such as birds, for more information see "Q & A: Dogs and Cats" ([www.cdc.gov/ncidod/dvbid/westnile/qa/wnv\\_dogs\\_cats.htm](http://www.cdc.gov/ncidod/dvbid/westnile/qa/wnv_dogs_cats.htm)).

For more information on disease in animals, see "WNV Vertebrate Ecology" ([www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm](http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm)).

## West Nile Virus: Epidemiologic Information for Clinicians

(continued from previous page)

### Related Links

- “Interjurisdictional Data Sharing and National Reporting of Human Cases” (Section 5 from “Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control”): [www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf](http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf)

For more information, visit [www.cdc.gov/westnile](http://www.cdc.gov/westnile), or call the CDC public response hotline at (888) 246-2675 (English), (888) 246-2857 (español), or (866) 874-2646 (TTY).

September 29, 2004

Page 4 of 4