

West Nile Virus: A Poultry Perspective
Andrea M. Miles, DVM, PhD Diplomat American College of Poultry Veterinarians
Poultry Health Management
NCSU-CVM

More people in the USA are worried about becoming infected with West Nile virus (WNV) than being a victim of terrorism or being exposed to anthrax (Gallup Poll Sept. 2002). I think that is a realistic perception of the threat. Recent events suggest that the virus has evolved to become more pathogenic (causes more disease). Since the mid 1990s there has been an increase in frequency of outbreaks in humans and horses and an increase in the number of severe human cases. Today I'd like to give you some basic information about the virus, tell you why it is such a concern for people, but not chickens or turkeys, and then give some information on how you can reduce exposure.

Incidence of Disease

Table 1 shows the increasing number of human cases in the USA since 1999. There have also been outbreaks in other countries since then, including Romania, Russia, and Israel. Coinciding with the human cases in Israel and the USA there have also been high avian death rates. The virus has been identified in at least 111 species of birds in the USA.

Table 1: Human cases in USA

Year	# of Human cases of WNV
1999	62
2000	21
2001	66
2002	As of Oct 6 = 2,703

Although we may think of West Nile virus as a new disease, it has actually been a problem in other countries for many years. It was first isolated in Uganda in 1937. It is endemic (a consistent problem) in some regions of Africa and Asia, Europe and now North America. It was first reported in the United States until the summer of 1999. That summer it caused viral infections in people, birds, and horses in and around New York City. Of the 62 people found to be infected, seven died. Since then, WNV has spread down the eastern seaboard and throughout the midwestern US. WNV has been detected in 44 states (all but the 7 westernmost states) and the District of Columbia, as well as in Manitoba, Ontario, Quebec, and Saskatchewan provinces in Canada. Cases have been confirmed in Mexico, from people with a history of travel to the US. As of 6 October, the Centers for Disease Control and Prevention have verified 2703 human cases of West Nile virus in the USA in 2002, resulting in 146 deaths.

In North Carolina infection has been reported in 2 residents who acquired the infection here and three others who acquired the infection while in other states. When people have flu-like symptoms and WNV is suspected, they are also tested for other arboviruses. We also have other arboviruses here including, St. Louis virus, eastern equine encephalitis virus, western equine encephalitis virus, Venezuelan equine encephalitis virus, and LaCrosse encephalitis virus. Actually LaCrosse virus has been much more prevalent in NC this summer, 15 residents were found positive for that virus.

Virus Life Cycle

Figure 1 shows the life cycle of WNV. Birds serve as a reservoir, but the virus only circulates in the blood of an infected bird for a few days. Mosquitoes become infected when they feed on infected birds. After an incubation period of 5 to 15 days, an infected mosquito can pass the virus onto another bird it feeds on. Mosquitoes can also pass the virus on to mammals, including people and horses. Mammals are incidental hosts, the virus replicates and causes illness but they do not help to spread the virus.

The most common vectors (agents that spread disease) are mosquitoes. *Culex* mosquitoes, which feed at dusk, are the most common species implicated in transmission of the virus to people. Recently more mosquitoes from the genus *Aedes* and *Ochlerotatus* have been implicated. This is a real concern because some of these mosquitoes feed on both birds and other animals. Thus they can spread the virus from birds to humans, horses and other animals. Also, some of these mosquitoes feed during the day, so avoiding exposure becomes more problematic.

WNV Disease in Mammals

Most humans, and other mammals infected with the virus, will not become severely ill, but they may experience flu-like symptoms. As with flu, death occurs in the very young, very old or immunocompromised. There is about an 18% death rate in people who become seriously ill. The clinical signs of infection include incoordination, partial paralysis, tremors and disorientation. There may be rapid onset of fever, headache and vomiting. The incubation period (time between when you become infected and when you feel sick) is 3-6 days. Reported infections are most common in people over 70. The states with the highest incidence of human disease in 2002 are: Illinois (690 cases), Indiana (204 cases), Louisiana (310 cases) and Michigan (445 cases).

The chances that an individual will become critically ill with WNV are fairly low. Less than 1% of mosquitoes in a WNV endemic area are infected and less than 1% of humans bitten by a WNV infected mosquito will become critically ill. Therefore, you have less than a 1/10,000 chance of becoming critically ill even if bitten by a mosquito carrying the virus. Recently we have also become concerned about contamination of donor organs and the blood supply. Transmission has been confirmed from a single organ donor to 4 organ recipients. There have been four reports of other patients who were diagnosed with WNV infection after receiving units of blood in the weeks before diagnosis. Because each of these patients resided in areas with high levels of WNV activity, the most likely mode of infection is mosquito exposure. To rule out blood transfusion-associated transmission, investigations are ongoing and efforts are under way

to contact donors of blood given to these patients and other recipients of blood from these donors for follow-up and WNV testing. In each instance, precautionary measures have included a withdrawal of any remaining blood products obtained from the donors whose blood was given to these patients. One woman, who may have obtained her infection from blood products, apparently transmitted the virus to her infant in breast milk. Mammals are incidental hosts, they become infected but do not spread the virus.

Of mammals, horses are the most susceptible. 30% of clinically sick horses die of the disease. The USDA has reported 6,223 equine cases in 34 states as of Oct 6 2002. The states with the highest number of cases are Iowa (403), Minnesota (537), Nebraska (914), North Dakota (530), South Dakota (573), and Texas (425). WNV has been associated with illness and death in several other mammals including dogs, cats, cows, and a wolf.

WNV Disease in Birds

WNV was first reported in NC during the summer of 2000, in a dead crow found at Lake Johnston, in Chatham County. In 2001 there were three additional positive reports, one in Cabarrus County and 2 in Camden County. During this past summer, WNV became endemic in the wild bird population in NC. As of 10-11-2002, dead wild birds with WNV had been reported in 57 counties in NC. About 75% of cases of WNV in dead birds are from crows and bluejays.

Passerine birds (which include crows, bluejays, pigeons) are suspected to be the main reservoir. Other dead birds found positive (throughout the USA) include bald eagles, golden eagles, ospreys, merlins, Cooper's hawks, and several species of owls. This summer there were die offs of "hundreds" of raptors throughout the mid-west. The virus also infects companion birds including zebra finches and maccaws. In total 111 bird species have now been recorded as killed, but because of the elusive behavior of sick birds and the efficiency of scavengers, most dead birds are never found. Those that have reached local laboratories for analysis represent only the smallest fraction of birds actually killed - a number thought to be in the tens of thousands.

Since wild birds were known to be a reservoir for the virus this raised concerns about domestic poultry. Thus experiments were performed to determine the pathogenicity of the virus in chickens (Senne *et al.*, 2000; and Langevin *et al.*, 2001) and turkeys (Swayne *et al.*, 2000). In all cases, inoculated birds became infected but neither chickens nor turkeys showed any obvious signs of infection. In addition, chickens or turkeys placed in contact with inoculated birds did not develop antibodies to the virus, demonstrating that a vector (such as a mosquito) was needed to transfer the virus from one bird to another. The level of viremia (amount of virus circulating in the blood) of inoculated turkeys was too low for them to provide a significant reservoir of virus to infect mosquitoes. However, during periods of peak viremia (around 4 days post infection) some chickens had high enough levels to act as a reservoir for infection of additional mosquitoes.

Since chickens can be infected, but not affected by the virus, they are a good candidate species to use as sentinels to monitor presence of the virus in an area. A cage of five to six chickens is placed in an area and samples of the bird's blood are withdrawn periodically to determine if they have been exposed to the virus. This system has been used in North Carolina and other states, for years, to monitor for other arboviruses (including eastern equine encephalitis virus). The North Carolina State Laboratory of Public Health tests each serum sample from sentinel chickens for antibodies for WNV, eastern equine encephalitis, Lacrosse, Highlands J, Saint Louis Encephalitis and California Group viruses. Results are reported to Public Health Pest Management as well as mosquito control programs and local health departments. Sentinel chickens have also been used in other states, however, monitoring of dead crows and blue jays for presence of virus has usually provided the first indication that the virus has spread to an additional state.

What to do if you find a dead crow or blue jay?

Contact Public Health Pest Management

919-733-6407

Wear latex gloves

Wrap bird in two plastic bags

Keep on ice

Must deliver carcass within 36 hours

What the NC government is doing:

Increased spraying for mosquitoes

Dead bird monitoring

Mosquito testing: 2,356 mosquito pools were tested in 2002, only one was found positive for WNV, 2 for CA group virus, one for eastern equine encephalitis virus and one positive for Highlands J virus.

Sentinel chicken testing: 20 flocks are being monitored, only one bird in one flock (in Currituck County) was positive for WNV, 2 were positive for eastern equine encephalitis virus, 4 were positive for Highlands J, and one was positive for CA group viruses.

Vaccines:

Scientists in the US are working on a recombinant DNA vaccine and scientists in Israel have been working on a 'killed' vaccine, which has also showed early promise in laboratory trials. On August 1, 2001 USDA issued a conditional license to Fort Dodge for a WNV vaccine for horses. This vaccine has also been used for birds in zoos and wildlife rehabilitation centers without any adverse affects. American Bird Conservancy in partnership with the American Zoo and Aquarium Association, and with support from Disney Wildlife Conservation Fund, has led efforts to develop a West Nile vaccine for birds. The first round of trials, carried out by The Centers for Disease Control and Prevention in Fort Collins, Colorado, have now been completed with encouraging results: inoculated birds showed a 60% increase in survival rates over unvaccinated birds in lab tests.

What you can do to reduce exposure:

Mosquitoes can breed in any puddle that lasts more than 4 days. Dispose of any water-holding containers, including discarded tires, buckets, empty cans, food and beverage containers. Drill holes in the bottom of containers that are left outdoors. Change water in birdbaths or wading pools, and empty flowerpot saucers of standing water at least once a week. Clean clogged roof gutters annually. Turn over plastic wading pools or wheelbarrows when not in use. Aerate ornamental pools or stock them with fish, such as *Gambusia*, that eat mosquito larvae. Clean and chlorinate swimming pools that are not in use and be aware that mosquitoes can breed in the water that collects on swimming pool covers. Check around faucets and air conditioner units and repair leaks. Use landscaping to eliminate standing water that collects on your property. Thoroughly clean livestock watering troughs monthly.

Wear insect repellent. Avoid infected areas at dawn and dusk (this was recommended last year, but now authorities say this may not make a difference). Make certain that doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes in them.

Sources of additional information:

USDA-- www.aphis.usda.gov

The Centers for Disease Control and Prevention (CDC) website now contains updated counts (as of close of business the preceding day, Monday-Friday) of human cases of West Nile virus infection by state.

The weblinks are:

www.cdc.gov/od/oc/media/wncount.htm

www.cdc.gov/od/oc/media/wntrend.htm

The general page leading to all links, including mapping of virus activity and comparisons by years is:

www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm

Morbidity and mortality Weekly Report

www.cdc.gov/mmwr/preview/mmwrhtml/mm5135a5.htm

Annals of the New York Academy of Science; WNV Detection, Surveillance and control
www.annalsnyas.org/content/vol951/issue1

National Veterinary Services Lab: 515-663-7551

NC State Public Health Laboratory: 919-733-7544

Public Health Pest Management Office: (877) 790-1747 (919) 733-6407

Fort Dodge-- Professional Services – Equine vaccine: (800) 533-8536

For information about pesticides used to control mosquitoes, contact the National Pesticide Information Center (NPIC) at 800-858-PEST (800-858-7378), visit: <http://npic.orst.edu/> and click on "West Nile Virus Resource Guide" or visit the Environmental Protection Agency's (EPA) website: <http://www.epa.gov/pesticides/factsheets/skeeters.htm>

Figure 1: West Nile virus life cycle

West Nile Virus Transmission Cycle

