LIVING WITH WEST NILE DISEASE

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Take Home Message:

1. West Nile Virus (WNV) can cause severe encephalitis or meningoencephalitis in humans, horses and some species of birds.
2. WNV cycles between many species of birds and mosquitoes.
3. Once the level of virus becomes high in mosquitoes and birds, human and horse infections occur.
4. Horses can be vaccinated against this virus.
5. Integrated mosquito management is important in disease prevention.

West Nile Disease

West Nile virus had never been seen in the Western Hemisphere prior to 1999 and it has a geographic range greater than any other known arbovirus. It is found throughout Africa and north to central Europe and eastern Asia. The earliest epidemic of WN fever occurred in Israel in the early 1950's involving over 500 hospitalized patients. The largest epidemic of WN fever on record occurred in South Africa during 1974. This epidemic involved an area of about 2500 km^2 in the Karoo and southern Cape provinces and resulted in thousands of human infections. More recently, epidemics of WN fever have occurred in Romania (1996-97), Czechland (1997), Italy and Israel (1998), Russia (1999) and Israel and France (2000), so that it is considered a re-emerging mosquito-borne disease in Europe. How WN virus managed to be introduced into the United States is unknown, nor is it known how long it has been here. There is speculation that it was through the importation of birds, or possibly a mosquito transported to the US by ship or airplane.

West Nile virus is a member of the Japanese encephalitis virus complex of the genus *Flavivirus*, family Flaviviridae, which includes nine viruses distributed around the world. In the United States, the complex has two representatives: Powassan and St. Louis encephalitis viruses, both which cause encephalitis in humans. The epidemiology of WN virus is nearly identical to that of SLE virus, principally carried by species of *Culex* mosquitoes and have birds as the reservoir. WN virus causes disease and mortality in humans, wildlife (birds, particularly crows), and domestic animals, particularly horses, whereas, St. Louis encephalitis does not cause any remarkable disease in wildlife or mammals other than man.

Epidemiology: Early outbreaks of WNV occurred in horses in 1962 in France, 1963 in Egypt, 1996 in Morocco, 1998 in Italy and Israel, 2000 in France and Israel and now in 1999, 2000, 2001 and 2002 in the US and in parts of Canada. In the early outbreak in France they recorded a 10% morbidity with a 30% mortality rate. In Egypt they report prevalence of infection from 14 to 89%, depending on the area tested. However, morbidity and mortality data was not available. In Morocco, the case fatality rate was 44.7% (42/94) and in Italy it was 6/14 (42%). In the 2000 outbreak in Israel, 15/76 (19.7%) horses died or were euthanized. In the US in 1999, 9 of 25

(36%) horses with clinical signs of the disease died or were euthanized. In 2000, there were 60 cases of WNV reported in horses from 7 states (NY, NJ, CT, DE, MA, PA and RI) and the case fatality rate was ~38%. During 2001, there were 738 confirmed cases of WNV in horses in 19 states. Follow up data is not available on all 2001 cases, however, approximately 25% of the cases that had been followed up had died. As of November 1st, 2002, there have been 11,957 equine cases of WNV from 38 states with presence of virus in 43/48 states so far. In addition, the presence of WNV has been confirmed in 5 Canadian provinces as well.

In Ohio in 2002, we had our first equine cases of WNV. As of November 1st, there were 636 horses diagnosed positive for WNV using the West Nile-specific IgM ELISA. Horses from 76 of Ohio's 88 counties were positive. Over 1/3 of the cases were from 2 counties where there are considerable wetlands and a very large marsh area. West Nile virus has been detected in birds in all 88 counties and in 16 species of mosquitoes in 45 counties.

Clinical Signs*:* All cases examined in an outbreak of the disease in Italy exhibited varying degrees of ataxia and weakness in the pelvic limbs. Asymmetric weakness was detected in the rear limbs of some horses. Some cases also had involvement of 1 or both thoracic limbs. In 6 cases, there was progression of clinical signs with ascending paresis leading to tetraplegia and recumbency within 9 days. Depressed mental state and tremors were noted in a few cases, however, there were no behavioral or head posture abnormalities or signs of cranial nerve involvement. This was similar to the outbreak in France in 2000. In the US cases, death or euthanasia usually occurred within 3 to 5 days of onset of clinical signs, except in 1 case that lived for 14 days. Clinical signs reported in US horses include ataxia (85%), depression or apprehension (50%), weakness (48%), recumbency (45%), muscle fasciculations (40%), fever (23%), paralyzed or droopy lip (18%), twitching muzzle (13%), teeth grinding (7%) and blindness in 5% of cases. What stands out in horses with severe clinical signs are the profound depression, weakness with pronounced hyperesthesia and mentation changes. The clinical signs in horses were very similar to the signs seen in horses in Israel in 2000. In contrast to the lack of cranial nerve signs and cerebral changes in the Italy and France equine cases is likely attributable to the strain of virus as the US strain is very similar to the goose strain from Israel.

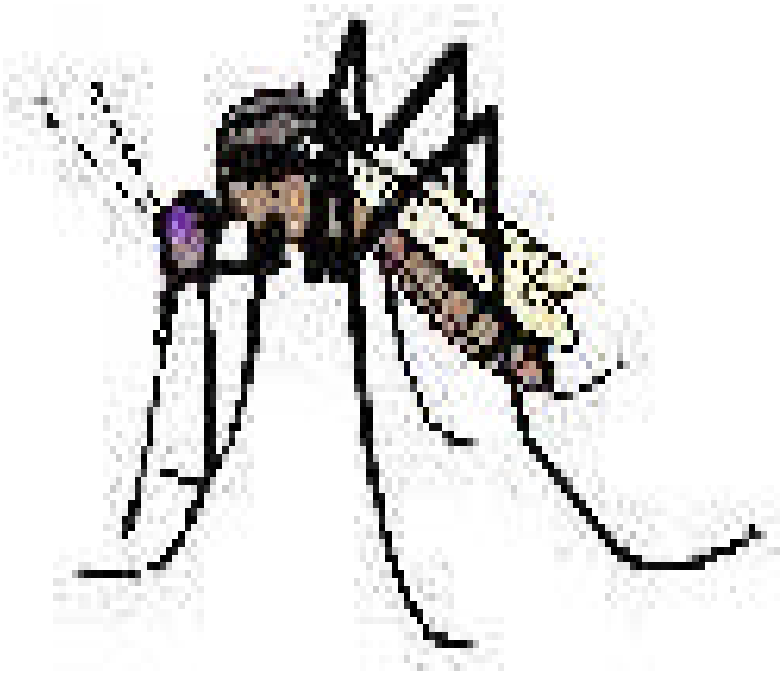
Pathology*:* No gross pathologic lesions were detected. Histologically, all animals exhibited slight to moderate nonsuppurative encephalomyelitis, primarily in the spinal cord and lower brainstem affecting both grey and white matter. The preponderance of lesions are in the grey matter thus leading to the profound weakness. The most severe lesions were in the thoracic and lumbar spinal cord.

Diagnosis*:* Due to the zoonotic potential of WNV, all horses who develop neurologic signs from August to October (or later in some areas) should be considered WNV suspects, particularly if the virus has been detected in the area close to the animal you are examining. Whole blood, serum and CSF samples should be submitted to the appropriate laboratory. Several serologic tests have been used to diagnose WNV disease including plaque reduction neutralization test (PRNT), hemagglutination inhibition (HI), complement fixation (CF) and enzyme-linked immunosorbent assay (ELISA). PRNT requires BSL3 laboratory capabilities. Antigen capture ELISA is used in humans and horses for IgM and IgG and is the test of choice for most laboratories. Complete histories should be submitted with all samples.

If the animal is demonstrating rapidly progressive neurologic signs with recumbency, the animal should be submitted to the diagnostic laboratory in your area for rabies and WNV testing. Two other diseases that need to be considered include botulism and equine protozoal myeloencephalitis (EPM). Other diagnostics include PCR of CNS tissues and immunohistochemistry. If you decide to perform a post-mortem in the field, please refer to USDA guidelines (See OSU web site below).

Treatment: Supportive treatment is the only treatment available. Anti-inflammatory medications such as DMSO, banamine or phenylbutasone, and in severely affected cases, use of corticosteroids are indicated. Some horses are treated with mannitol to reduce the edema in the brain or spinal cord, however, the cost may be prohibitive. Use of antiviral agents or interferon-α have not been demonstrated to be effective, but are being used in humans. Oral vitamin E at 5,000 to 8,000 IU daily per os is indicated as an anti-oxidant as long as the horse is still eating. Some horses may require intravenous or oral fluids, as well as slings may be necessary if the horse is recumbent and unable to rise.

Prevention*:* The main prevention at this point in time is mosquito control. Reduce Mosquito Breeding Sites; Decrease Exposure to Adult Mosquitoes; Screened housing; Insect repellents; Reduce Outdoor exposure. Local mosquito control authorities may be able to help in assessing the mosquito breeding risks associated with a specific property.[Ostlund, 2000]



Here are other ways to protect horses:

- Eliminate standing water on their property, to prevent mosquito breeding.
- House horses inside at dawn, dusk, and night, which are peak mosquito times.
- Avoid leaving lights on inside horse stables in the evening or overnight.
- Place incandescent bulbs around the perimeter of stables.
- Use fans to create air movement over stabled horses.
- Remove all birds, including chickens, that are in or close to stables.
- Use mosquito repellent on horses.
- Fog stables with pesticide in the evening.

At the present time there is a killed vaccine in use in the US. This vaccine requires a booster 3 to 6 weeks after the initial vaccination and should be boostered at least once a year, depending on your place of residence. In Ohio, the recommendation is that the horse receive the second dose no later than April 15th so there are approximately 4 weeks post second vaccination when the mosquito season begins. That timing may be different in Alberta, depending on when the first mosquitoes appear. There are some horses that do not respond well to the vaccine as limited numbers of properly vaccinated horses have contracted the disease. However, no vaccine is 100% protective. That also solidifies the need for Integrated Mosquito Management.

An Example of how to Prepare for West Nile's Appearance:

In the fall of 1999, following the outbreak of West Nile Virus infections in New York, the author was approached by the Ohio Department of Health Vector-Borne Disease Unit (ODHVBDU) to host a meeting of interested parties to form the Ohio West Nile Virus Work Group. Although we did not expect the virus in Ohio in 2000, we had a few meetings to discuss what was going on as no one knew how the virus was going to spread throughout the year.

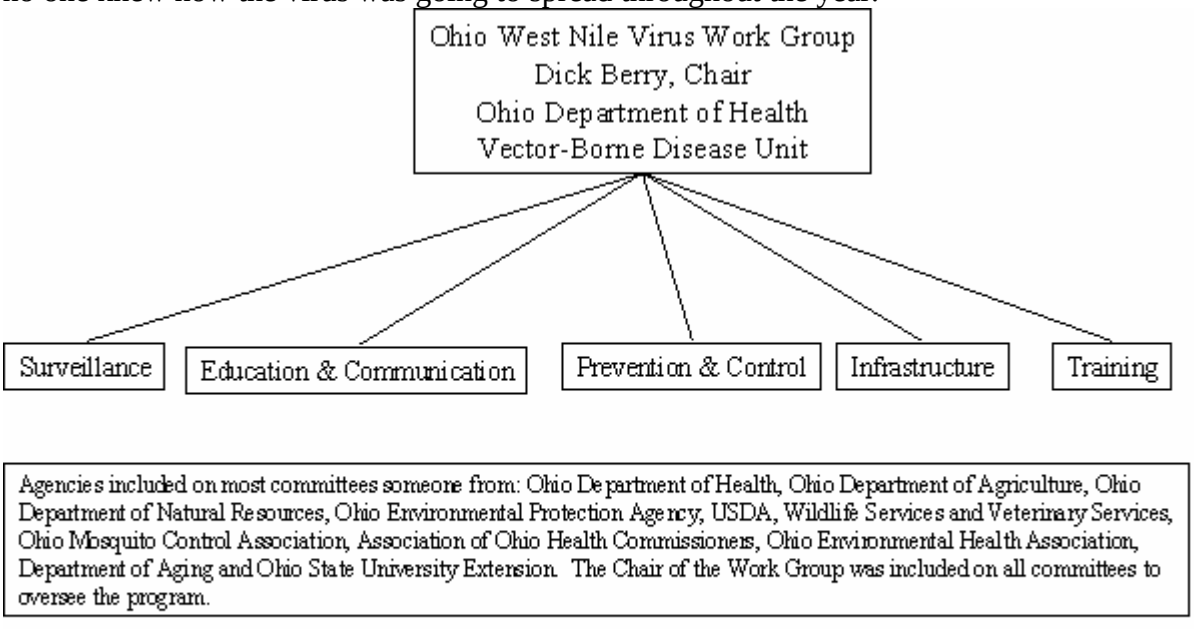


Figure 1. Organization of the Ohio West Nile Virus Work Group and the agencies involved in implementing the response plan.

The rapid spread of the virus west across the state of New York and parts of Pennsylvania were a major concern. When the virus was detected in Erie county, Pennsylvania right next door to Ashtabula county, Ohio in the fall of 2000, decisions were made to prepare for the following year. A mandate was put forth by the Directors of Health (ODH), Agriculture (ODA), Natural Resources (ODNR) and Environmental Protection (OEPA) that the Ohio West Nile Virus Work Group to develop a response plan for the state of Ohio. The group formed subcommittees to deal with 5 separate issues: education and communication, surveillance, infrastructure, training, and prevention and control (Figure 1).

Organization and Purpose of Work Group

The mission of each of the 5 subcommittees was to develop their portion of the response plan, as well as, implement methods to deal with their particular area. Education and communication developed educational materials along with lists of the important people to receive this message, and the best method of delivering this information. Since New York and Pennsylvania had already done all of this preparation, we at least had a baseline guide to use in our efforts. Fact sheets we prepared were formatted and distributed throughout the state by The Ohio State University Extension service and Local Health Department personnel. In Ohio, there are over 1600 Extension personnel, which meant that we could get the information out to the grass-roots level. Web sites were prepared by the Departments of Veterinary Preventive Medicine, and Ohio Departments of Health and Agriculture, for access to educational materials and updates. Communication was coordinated through various agencies with numerous articles sent out through lay publications, newspaper, televison and radio interviews to educate the public. Newsletters from such organizations as Ohio Veterinary Medical Association and the Ohio Department of Agriculture were used to send information to veterinarians. An additional mode of delivery was the Ohio State University Extension service interactive video system.
From the campus we were able to interact with the 5 District Extension offices and deliver the message to both Local Health Department and Extension personnel to work together educating the public about mosquito control and personal protection. In Ohio, we also have a satellite system to deliver the message to 100 sites throughout the state, including 93 Extension offices and 7 leadership centers which we used fairly successfully in 2002.

The infrastructure subcommittee was primarily the budgetary committee which was responsible for assessing the needs of the public, what do we have as far as infrastructure and what are the needs of all the agencies. A budget was submitted for 2001 in the amount of $32 million dollars, unfortunately, the state of Ohio was coming into a budget crisis, so there was no funding for the Work Group. Needless to say, many things needed were not available, particularly in the less fortunate counties.

Surveillance systems were established for humans, horses and birds. Surveillance for mosquitoes had been in effect for over 30 years, therefore, only slight modifications were required in order to allow for WNV testing to be included with St. Louis Encephalitis virus (SLE) and Eastern Equine Encephalitis virus (EEE). We started with an antigen-capture ELISA for the mosquito pools, but due to sensitivity problems with the test, were able to add RT-PCR by the end of 2001.

The system we used for the dead crow and blue jay surveillance put the onus on the local health departments as the dead crow incidence may be used to predict risk. We established a Dead Bird Report Form where the information could be phoned in to the Ohio Department of Health or they could be faxed. Hundreds of phone calls later, we have decided this information would better be collected on a local level, so for 2002 and beyond, the local health departments will keep track of that information. We elected to stay with just crows and blue jays for diagnosis of the presence of WNV, based on the experience in 1999 and 2000 from New York and other areas. The local health departments were to be responsible for collecting the dead birds and shipping appropriate specimens to the Ohio Department of Agriculture, Animal Disease Diagnostic Laboratory (ODA/ADDL). The laboratory would collect pathology samples and they were shipped to the ODHVBDU for testing using RT-PCR.

For equine surveillance, a mechanism was established through the ODA/ADDL for collection of serum and CSF samples from horses with clinical disease suggestive of WNV. This was coordinated through practitioners, as well as, through the Veterinary Teaching Hospital at The Ohio State University. Those samples collected were tested at ODA/ADDL using the IgM-specific WNV ELISA. Until the laboratory was comfortable with their results, the samples were confirmed at NVSL in Ames, IA using the IgM-specific WNV ELISA and plaque reduction neutralization test. We initially set up a system where positive birds or mosquitoes would generate ring testing in a 2 mile radius for horses potentially exposed. However, after our first positive bird this was carried out we discontinued this procedure as the results were completely unrewarding. We did establish another surveillance mechanism for horses where we targeted coggins samples from horses sampled in counties that did not have any type of mosquito surveillance program, nor any mosquito control which occurred in approximately 20 counties. We felt this information would help us target specific counties in the future. After the results of the testing, we found that this effort was not rewarding. This is because most horse positives do not occur until after the first bird cases. In 2002, there were a few counties that had horse positives prior to any others, however, that was due to the lack of bird and mosquito surveillance.

Human surveillance was conducted through the ODH by targeting physicians where they encounter cases of viral encephalitis, viral meningoencephalitis or viral (aseptic) meningitis either confirmed or suspected. In Ohio, these cases are reportable, therefore, most cases will be tested using an arbovirus screen. This process has been effective for detection of other arboviruses for some time and resulted in a number of cases tested for WNV in 2001 and 2002. This year in Ohio, over 700 human samples have been tested with greater than 400 positive cases.

The training subcommittee focused their efforts on the training of vector control staff in the various areas of the state where mosquito control was practiced. Some counties have developed extensive mosquito control programs over the years and they were most helpful to the less fortunate counties. The training was comprised of literature, lectures, exams and workshops for staff to gain hands-on experience with the use of pesticides and the available equipment with which to apply them.

Lastly, the prevention and control subcommittee was set up to address citizen behaviors regarding personal protection from mosquitoes and mosquito control activities. Issues addressed included reduction of standing water to prevent development of mosquitoes, available larvicides and their use or integrated mosquito control. They also addressed emergency mosquito control should there be a large outbreak of WNV in humans.

Contents of this example were presented by the author at the American College of Veterinary Internal Medicine Forum, Dallas, Tx in May, 2002.

CONCLUSION

West Nile Virus and subsequent disease from the virus are a reality even in the province of Alberta. As you all know there have been approximately 121 cases of human WNV disease in Canada in 2002. In addition, there have been over 100 equine cases in Saskatchewan, Manitoba and Ontario. The rapid East to West spread in the US and Canada would suggest that Alberta and British Columbia are next. The virus is likely in the Western Hemisphere to stay and will be something we have to deal with on a yearly basis.

Ohio State University Web Site developed by the author:

http://prevmed.vet.ohio-state.edu/Extension/WestNile/WNV.htm