West Nile Virus: Background Information and a Characterization of Its Equine Cases in Colorado and Nebraska in 2002

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Background Information on West Nile Virus

West Nile Virus (WNV) infects a wide variety of bird and animal species, and has had a wide geographic distribution. The virus was first recognized in 1937, but was not diagnosed in the Western Hemisphere until 1999 when it was introduced into the eastern United States and caused disease in birds, horses and humans. Since that time, WNV has become endemic in the U.S., spreading further westward each subsequent year during warm weather. In 1999, WNV affected horses were found in only two counties in New York. In 2000, 7 northeastern states had confirmed equine cases and in 2001, the virus had spread to infect horses in 20 states. During 2002, over 14,700 laboratory-confirmed equine cases of WNV infection had been reported in 43 states[a]. There were more confirmed equine cases than initially predicted in the plains and western states.

Disease associated with WNV infections has been primarily recognized in the United States in birds, humans and horses. Evidence of exposure to the virus has been documented in other species of animals, but occurrence of disease thus far has been rarely recognized. While birds are the primary reservoir host for WNV, the principal vectors are a variety of mosquito species. Mosquitoes are responsible for transmission among birds, as well as from birds to incidental hosts such as humans and horses. Unlike WNV in various bird species, the virus does not amplify sufficiently in infected horses and humans to infect mosquitoes and allow spread to other susceptible hosts. A wide range of bird species have been recognized to be infected with WNV, but severe illness and death has been primarily recognized in the U.S. in the corvid species (blue jays, crows, and ravens).

[a] USDA:APHIS: www.aphis.usda/gov/lpa/issues/wnv/wnv.html. January 2003

Several ecological factors have influenced the spread of WNV and patterns of disease in the U.S. Because the virus is primarily spread by mosquito vectors, conditions that facilitate amplification of mosquito populations increase the likelihood of infection when the virus is present in local bird populations.

Several strategies that may be useful for the control of WNV in horses exist. These include limiting exposure of the animal to mosquitoes, using repellents to discourage mosquito feeding activity, discouraging mosquito breeding activity, and increasing specific immunity to WNV through vaccination. Your veterinarian is an excellent source of information about preventing WNV infections. In addition, there are a variety of information sources regarding mosquito control and WNV prevention, including the following websites:

- http://prevmed.vet.ohio-state.edu (click on Extension Programs)
- www.bugspray.net
- www.mosquito.org
- www.entsoc.org
- http://www.ext.colostate.edu/pubs/insect/05526.html

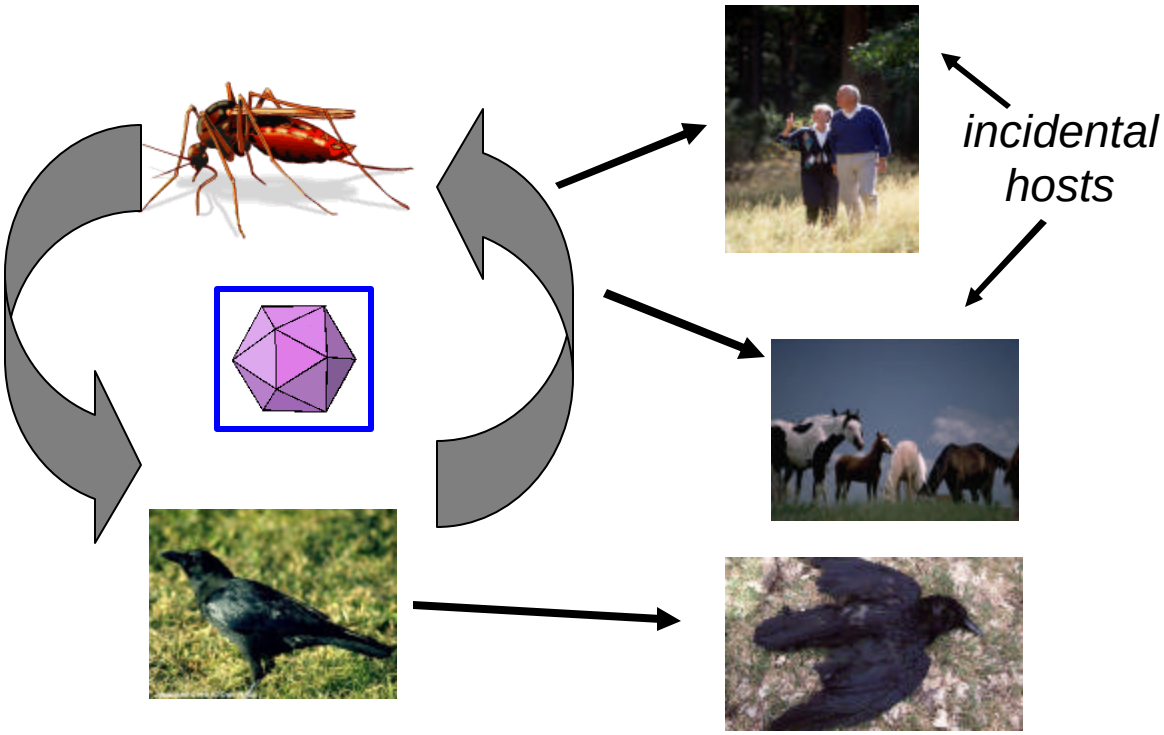
Effective control measures that should be considered for WNV prevention include discouraging mosquito breeding activity near your horses by minimizing standing water on the premises and cleaning water tanks or other sources of drinking water at least weekly. Improving the overall cleanliness of the premises can also limit vector activity, so frequent removal of manure and removing or trimming weeds can be beneficial. In addition, keeping horses indoors during peak mosquito feeding times such as at dusk and dawn and turning off barn lights or using fluorescent lights can minimize attraction of adult mosquitoes into the barn. Using fans to move air in stabling areas can also reduce mosquito feeding, but be sure to prevent horses from accessing electrical cords. Applying insect repellents that contain permethrins to horses especially during peak mosquito feeding times can also repel adult mosquitoes.

A WNV vaccine first became available for use in horses in August of 2001, and is now fully licensed by the USDA as a means to prevent viremia in horses exposed to WNV. This vaccine is only available through veterinarians; please consult your veterinarian regarding specific immunization recommendations for your horses. In general, the manufacturer recommends that adult horses receive two vaccinations three to six weeks apart, and that foals receive three vaccinations during the same interval. The full series should be completed prior to vector season. Once this priming series is completed it may require several weeks for peak immunity to develop. After horses have received an initial priming series of vaccinations, booster vaccination should be administered at least annually prior to vector season. It is not clear at this time how long horses are protected after vaccination, and it is possible that horses may need more than one booster vaccination per year, especially if WNV activity is high.

During the infectious diseases forum at the American Association of Equine Practitioners meeting in December of 2002, Dr. Maureen Long from the University of Florida's College of Veterinary Medicine indicated that out of 463 documented equine WNV cases in Florida, only 44 had received two or more doses of the vaccine. Further investigation of these 44 cases is underway by Dr. Long to determine the duration of time from last vaccination to onset of disease. She also indicated that most horses that developed clinical WNV infections throughout the U.S. in 2002 had not received the recommended two doses of vaccine. These data suggest that the vaccine may be useful in preventing disease associated with WNV infections in horses.

In 2002, WNV infections were most common in the central U.S. There were a total of 378 laboratory-confirmed WNV infections in horses in Colorado (CO) and 1100 cases in Nebraska (NE). In order to describe the occurrence of disease among horses in the western U.S. and to investigate the long-term consequences of WNV infection in horses as well, the State Veterinarian's Offices in Colorado and Nebraska, the Nebraska Veterinary Diagnostic Center, and the Colorado State University College of Veterinary Medicine collaborated to conduct a survey of owners of horses affected by WNV in 2002.

The life cycle of West Nile Virus showing the primary cycle between birds and mosquitoes with horses and humans as incidental hosts.



Many bird species can act as a reservoir for WNV, but Corvids are very susceptible to disease

Summary of Characterization of Equine WNV Cases in Colorado and Nebraska

Design of the Survey

The objective of this survey was to describe the equine West Nile virus cases in Nebraska and Colorado in order to better understand the progression of clinical disease, clinical signs, and clinical outcome.

Funding for this project was provided through a special grant from the United States Department of Agriculture, the Cooperative State Research Education and Extension Services for the Colorado State University Program for Economically Important Animal Diseases (PEIIAD). The State Veterinarians' Offices in Nebraska and Colorado and the University of Nebraska Veterinary Diagnostic Center provided support via access to pertinent records and laboratory forms, and through personnel designated to assist with the project.

This survey represents a collaborative effort between the State Veterinarians in Colorado and Nebraska, the Diagnostic Laboratory in Nebraska and Colorado State University (CSU) College of Veterinary Medicine and Biomedical Sciences- Animal Population Health Institute (APHI). A telephone survey was developed for administration by 25 honors veterinary students from the Colorado State University College of Veterinary Medicine and Biomedical Sciences. A script was also developed to maximize the likelihood that data were gathered in a uniform manner and to ensure that objectives of the study were adequately relayed to owners of affected horses.

Owners of affected horses were randomly selected as study participants from the list of 1478 WNV infected horses that were confirmed by laboratories in Colorado and Nebraska. CSU honors veterinary students attempted to contact 819 selected owners between September 20, 2002 and January 31, 2003, at least 30 days after laboratory confirmation of disease. At least three attempts were made to contact owners. Data collected for analysis included information from the laboratory submission forms, as well as information collected during the telephone interviews. In addition, some owners granted permission to contact their veterinarian if they did not personally have information about the treatment or clinical status of their horse(s).

Results

Owners of 536 of 819 affected horses originally selected for participation were successfully contacted by telephone. Among these owners, 92% agreed to participate in the study (493/536).

The average age of horses affected by WNV in Nebraska and Colorado was 9 years, but there was a broad age range among these horses (3 months to 35 years). Among these affected horses, 9.4% were intact males (including adults and juveniles), 44.4% were castrated males, and 46.2% were females.

The vast majority of WNV cases in Nebraska and Colorado were Quarter Horses (64%), which is likely a reflection of the population at risk in this region of the country. Other affected horses included Appaloosas (4%), Arabians (6%), Morgan Horses (1%), Mustangs (1%), Paints (9%), Tennessee Walking Horses (0.2%), Thoroughbreds (5%), Pony of the Americas (0.2%), Miniature Horses (0.4%), Paso Finos (0.3%), Missouri Fox Trotters (0.3%), Shetland Ponies (0.4%) and Welsh Ponies (0.3%). All warmblood breeds comprised about 0.3% of affected horses, while the draft horse breeds comprised 1.7%. A total of 30 cases were categorized as "nonregistered breeds", including "crossbreeds" (3%), "grade" horses (1.3%), "ponies" (0.4%) and one case that the owner could not specify breed (0.2%). There were also five mules and two donkeys with clinical disease associated with WNV infection.

The survival status was available for 482 clinically affected horses. Of these, 71.4% (344/482) were still alive at the time of telephone interviews (a minimum of 30 days after signs were initially detected), and the remaining 28.6% died or were euthanized. Horses that died were on average older than those that survived (average= 10.8 vs. 8.9 years).

Where vaccination status was available, approximately 47% (277/589) of the affected horses in the study had received at least one dose of the WNV vaccine before becoming a case. Seventeen animals (3.0%) were vaccinated only after clinical signs were displayed, and 295 (50%) were non-vaccinated. Of the cases for which vaccination status for WNV was known, 89 animals with clinical WNV infections had reportedly received two vaccinations for WNV prior to becoming a case; however, only 15 of these animals received their second WNV vaccination at least four weeks prior to becoming a case. Thirteen out of these 15 cases were vaccinated according to the recommendations for vaccination in year 2002 (received their two WNV vaccinations at the recommended 3-6 weeks apart and received the second vaccination at least four weeks prior to exposure) displayed signs of WNV infection. Survival status was known for 12 of these 13 affected horses, and all 12 of these animals survived.

The case fatality rate among the WNV cases that had been vaccinated a minimum of one time prior to onset of signs was 20.3% while 36.6% of unvaccinated animals had died or were euthanized at the time of the survey. There was no detectable difference in the case fatality rate between horses that were vaccinated after the onset of clinical disease and those that were not vaccinated.

The clinical signs most commonly seen by owners in their affected horses included ataxia (a staggering or drunk-like gait; 73%), weakness (69%), lethargy or depression (61%) and muscle fasciculations (60%). Weakness was more often severe in the hind limbs. Muscle fasciculations occurred most commonly on the face and in the fore quarters. Affected animals were also commonly reported to stumble (51%), showed body stiffness or reluctance to move (43%), were unable to rise on their own (38%), had decreased appetite (36%), prolonged periods of recumbency with ability to rise (35.%), fever (35%), altered mentation (31%), hyperesthesia (30%), lameness (30%) and cranial nerve deficits manifesting as droopy ears, lips, muzzle or tongue (27%).

Other less commonly observed clinical signs included assuming a "dog-sitting" posture (15%), difficulty eating (13%), exaggerated gait (hypermetric gait; 12%), muscle atrophy (10%), compulsive behavior (10%), assuming a "praying posture" (4%) and head-pressing (4%). Owners reported that horses had other abnormal behaviors not specifically asked about in interviews in 14.5% of animals in our survey, including generalized agitation and restlessness, apprehension, aggression, abnormal vocalization, bruxism, head shaking behavior, abnormal chewing motions, yawning or smacking the lips, and repeatedly looking back at the hindquarters.

More rarely reported clinical signs included generalized edema or swelling, abnormalities in respiratory effort or rate, eye abnormalities including apparent blindness, nasal discharge, coughing, increased salivation, neck stiffness, noise sensitivity, straining to urinate, hypothermia, increased urination and increased water intake, dull hair coat, altered motility in the digestive tract and/or diarrhea, decreased tail tone, dribbling urine, constipation, fecal incontinence, subcutaneous emphysema, inability to lie down, abortion, and found dead before any signs of illness were observed.

Owners reported treatments administered to 432 horses. Flunixin meglumine (Banamine®) was the drug most commonly administered to affected horses; 73% (315/432) of affected horses received this drug. Phenylbutazone was administered to 22% of horses (91/432), 52% received dimethylsulfoxide (DMSO; 225/432), oral or intravenous fluids were administered to 39% of horses (169/432) and 12 % (50/432) received vitamins. Twelve horses were treated by using a supporting sling to assist managing recumbency (3%; 12/432).

Of surviving animals, there were 82% (276/338) considered fully recovered by their owners at the time of the phone interview, although some residual signs of infection were still apparent in 21% of surviving animals. Some owners called their horses "recovered" but still reported some mild, lingering effects of disease. Decreased stamina was the most commonly reported residual sign of infection (21%; 15/71) followed by weight loss and/or loss of condition (18%; 13/71).

Owners were also asked whether other horses on their premises developed clinical signs thought to be associated with WNV infection, but were not confirmed using laboratory testing. Data collected from interviewing owners suggest that for each laboratory-confirmed case there was an average 0.7 additional WNV cases (approximately two unreported cases for every three laboratory-confirmed cases).

Conclusions

Results of this study suggest that WNV infections were associated with substantial impact for the equine industries in Colorado and Nebraska. The case fatality rate estimated from owner reports (28.6%) is similar to reports from other regions of the U.S. It appears that all ages of horses can become diseased due to WNV infection, as indicated by the broad age range of affected horses (3 months to 35 years). While older affected

horses were more likely to die, it was not possible in this study to determine if there is an age predilection for becoming infected or developing clinical disease, as only affected horses were included in the study population. Although not specifically investigated, it is possible that older horses were more likely to have severe signs, or their owners may have been more likely to elect to euthanatize these horses. Quarter Horses are the most common breed of horse in the western states based on equine demographic studies and they were the most common breed to be a WNV case. Further investigation is warranted to determine if they are over represented in the WNV case population. It appears that both donkeys and mules can also develop disease due to WNV infection.

The most common clinical sign associated with WNV infection identified in this study was an altered gait including reluctance to move, stumbling, perceived lameness, ataxia or weakness. With the emergence of WNV as a disease agent in the U.S., owners should immediately consult with their veterinarian if their horse develops these signs. Owners should also be alert to identify whenever their horse's behavior changes, such as appearing lethargic, having a diminished appetite, or developing a fever.

Affected horses were generally treated to control inflammation and provide supportive care. Recumbency with an inability to rise was reported in approximately a third of the cases and this clinical sign occurred more commonly in equids that died. Horses that are unable to rise can become very distressed and self inflict trauma or develop complications from being recumbent, which may have affected the likelihood of dying or being euthanatized.

This study was not designed to evaluate the efficacy of vaccination for preventing WNV infection or decreasing the likelihood of developing clinical disease. While some horses that were reportedly vaccinated according to manufacturer's recommendations developed clinical disease, immunity provided by the vaccination can be overwhelmed even when vaccines are very effective (100% protection against disease from *any* vaccine is not expected). Vaccinated horses were less likely to die or be euthanatized, which suggests that there is a measurable benefit associated with vaccination and that vaccination is recommended as a prophylactic measure. It is also important to employ other preventive measures, including mosquito control, when horses are at risk of exposure to WNV. Owners should consult their veterinarian to develop a disease prevention plan for WNV.