

CWD Update 102

October 20, 2011

State and Provincial Updates

Missouri:

The following press release was issued on October 20, 2011 by the Missouri Department of Agriculture

(http://mda.mo.gov/news/2011/Chronic_Wasting_Disease_Found_in_Captive_Deer):

Chronic Wasting Disease Found in Captive Deer

The Missouri departments of Agriculture, Conservation and Health and Senior Services and the U.S. Department of Agriculture announced that a captive white-tailed deer in Macon County, Missouri has tested positive for Chronic Wasting Disease (CWD). CWD is a neurological disease found in deer, elk and moose.

"We have a plan in place and our team is actively working to ensure that this situation is addressed quickly and effectively," said State Veterinarian Dr. Linda Hickam. "Fortunately there is no evidence that CWD poses a risk to humans, non cervid livestock, household pets or food safety."

The animal that tested positive for CWD was a captive white-tailed deer inspected as part of the State's CWD surveillance and testing program. Preliminary tests were conducted by the USDA National Veterinary Services Laboratory in Ames, Iowa.

Upon receiving the confirmed CWD positive, Missouri's departments of Agriculture, Conservation and Health and Senior Services initiated their CWD Contingency Plan. The plan was developed in 2002 by the Cervid Health Committee, a task force comprised of veterinarians, animal health officers and conservation officers from USDA, MDA, MDC and DHSS working together to mitigate challenges associated with CWD.

In February 2010 a case of CWD was confirmed in Linn County on a captive hunting preserve operated by the same entity, Heartland Wildlife Ranches, LLC. The Linn County facility was depopulated and no further infection was identified at that facility. The current case was identified through increased surveillance required by the management plan implemented from the previous CWD incident.

CWD is transmitted by live animal to animal contact or soil to animal contact. The disease was first recognized in 1967 in captive mule deer in the Colorado Division of Wildlife captive wildlife research facility in Fort Collins, Colorado. CWD has been documented in deer and/or elk in Colorado, Illinois, Kansas, Maryland, Michigan, Minnesota, Montana, Nebraska, New Mexico, New York, North Dakota, Oklahoma, South Dakota, Utah, Virginia, West Virginia, Wisconsin, and the Canadian Provinces of Alberta and Saskatchewan. There has been no evidence that the disease can be transmitted to humans.

"Missouri's proactive steps to put a testing protocol in place and create a contingency plan years ago is proving beneficial. We are in a solid position to follow pre-established steps to ensure Missouri's valuable whitetail deer resource remains healthy and strong," said Jason Summers Missouri's Deer Biologist, Missouri Department of Conservation.

For more information regarding CWD, please contact Missouri's State Veterinarian Dr. Linda Hickam at (573) 751-3377.

Federal Budget Update - USDA

The following excerpt regarding FY2012 USDA CWD funding was copied from the "2012 USDA Budget Explanatory Notes for Committee on Appropriations,"

<http://www.obpa.usda.gov/budsum>

<http://www.obpa.usda.gov/18aphis2011notes.pdf>:

Federal role in Chronic Wasting Disease surveillance activities (-\$13.926 million)

Chronic wasting disease (CWD) is a degenerative neurological illness affecting elk and deer (cervids) in North America. APHIS' activities related to this disease include: surveillance and management in both farmed and wild populations; assistance to State agencies for quarantine of affected animals and premises; humane euthanasia and testing affected and exposed animals; and, establishment of a voluntary Herd Certification Program (HCP) in coordination with States, the farmed cervid industry, and the U.S. Animal Health Associations.

The success of the voluntary HCP is based upon cooperation and shared responsibility between the Federal government and State and local interests. Since these are local or regional disease spread issues, State and local governments should assume a more active role and better anticipate and plan for future needs. The reduction will eliminate funding provided to States and Tribes through cooperative agreements and indemnity payments for CWD affected herds. APHIS plans to use \$1.826 million in FY 2012 to provide a Federal level of coordination for the voluntary Herd Certification Program.

Federal Budget Update – DHHS-CDC

The following excerpt regarding FY2012 CDC prion funding was copied from the Department of Health and Human Services Fiscal Year 2012 "Justification of Estimates for Appropriation Committees,"

http://www.cdc.gov/fmo/topic/Budget%20Information/appropriations_budget_form_pdf/FY2012_CDC_CJ_Final.pdf:

Prion Disease (-\$5.473 million)

The FY 2012 budget request reflects an elimination of the Prion Disease line (\$5.473 million). This program takes a disease-specific approach rather than a broad public health approach to infectious and zoonotic diseases. In addition, CDC is not able to demonstrate significant public health impact within this program at the current funding level.

Recent Publications

Detection of Chronic Wasting Disease Prions in Salivary, Urinary, and Intestinal Tissues of Deer: Potential Mechanisms of Prion Shedding and Transmission

Nicholas J. Haley, Candace K. Mathiason, Scott Carver, Mark Zabel, Glenn C. Telling, and Edward A. Hoover

Journal of Virology, July 2011, p. 6309-6318, Vol. 85, No. 13

Abstract:

Efficient horizontal transmission is a signature trait of chronic wasting disease (CWD) in cervids. Infectious prions shed into excreta appear to play a key role in this facile transmission, as has been demonstrated by bioassays of cervid and transgenic species and serial protein misfolding cyclic amplification (sPMCA). However, the source(s) of infectious prions in these body fluids has yet to be identified. In the present study, we analyzed tissues proximate to saliva, urine, and fecal production by sPMCA in an attempt to elucidate this unique aspect of CWD pathogenesis. Oropharyngeal, urogenital, and gastrointestinal tissues along with blood and obex from CWD-exposed cervids (comprising 27 animals and >350 individual samples) were analyzed and scored based on the apparent relative CWD burden. PrP^{CWD}-generating activity was detected in a range of tissues and was highest in the salivary gland, urinary bladder, and distal intestinal tract. In the same assays, blood from the same animals and unseeded normal brain homogenate controls (n = 116 of 117) remained negative. The PrP-converting activity in peripheral tissues varied from 10⁻¹¹ - to 10⁰-fold of that found in brain of the same animal. Deer with highest levels of PrP^{CWD} amplification in the brain had higher and more widely disseminated prion amplification in excretory tissues. Interestingly, PrP^{CWD} was not demonstrable in these excretory tissues by conventional Western blotting, suggesting a low prion burden or the presence of protease-sensitive infectious prions destroyed by harsh proteolytic treatments. These findings offer unique insights into the transmission of CWD in particular and prion infection and trafficking overall.

<http://jvi.asm.org/cgi/content/abstract/85/13/6309>

Minor Oral Lesions Facilitate Transmission of Chronic Wasting Disease

Nathaniel D. Denkers, Glenn C. Telling, and Edward A. Hoover

Journal of Virology, February 2011, p. 1396-1399, Vol. 85, No. 3

Abstract:

While chronic wasting disease (CWD) prion transmission, entry, and trafficking remain incompletely elucidated, natural exposure of the oral and/or nasal mucous membranes seems certain. Cervids commonly sustain minor lesions on oral mucous membranes that could have an impact on susceptibility to prion infection. To explore this potential cofactor, we studied cohorts of cervid PrP transgenic mice with or without superficial abrasions on the lingual mucosa to determine whether minor oral mucosa lesions may enhance susceptibility to CWD infections. Results demonstrated that minor lingual abrasions substantially facilitate CWD transmission, revealing a cofactor that may be significant in cervids and perhaps other species.

<http://jvi.asm.org/cgi/content/abstract/85/3/1396>

There Is No Safe Dose of Prions

Helen R. Fryer, Angela R. McLean

PLoS ONE 6(8): e23664. doi:10.1371/journal.pone.0023664

Abstract:

Understanding the circumstances under which exposure to transmissible spongiform encephalopathies (TSEs) leads to infection is important for managing risks to public health. Based upon ideas in toxicology and radiology, it is plausible that exposure to harmful agents, including TSEs, is completely safe if the dose is low enough. However, the existence of a threshold, below which infection probability is zero has never been demonstrated experimentally. Here we explore this question by combining data and mathematical models that describe scrapie infections in mice following experimental challenge over a broad range of doses. We analyse data from 4338 mice inoculated at doses ranging over ten orders of magnitude. These data are compared to results from a within-host model in which prions accumulate according to a stochastic birth-death process. Crucially, this model assumes no threshold on the dose required for infection. Our data reveal that infection is possible at the very low dose of a 1000 fold dilution of the dose that infects half the challenged animals (ID₅₀). Furthermore, the dose response curve closely matches that predicted by the model. These findings imply that there is no safe dose of prions and that assessments of the risk from low dose exposure are right to assume a linear relationship between dose and probability of infection. We also refine two common perceptions about TSE incubation periods: that their mean values decrease linearly with logarithmic decreases in dose and that they are highly reproducible between hosts. The model and data both show that the linear decrease in incubation period holds only for doses above the ID₅₀. Furthermore, variability in incubation periods is greater than predicted by the model, not smaller. This result poses new questions about the sources of variability in prion incubation periods. It also provides insight into the limitations of the incubation period assay.

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0023664>

White-tailed deer are susceptible to the agent of sheep scrapie by intracerebral inoculation

Justin J Greenlee, Jodi D Smith and Robert A Kunkle

Veterinary Research 2011, 42:107 doi:10.1186/1297-9716-42-107

Abstract:

Interspecies transmission studies afford the opportunity to better understand the potential host range and origins of prion diseases. The purpose of this experiment was to determine susceptibility of white-tailed deer to the agent of scrapie after intracerebral inoculation and to compare clinical signs and lesions to those reported for chronic wasting disease (CWD). Deer (n = 5) were inoculated with 1 mL of a 10% (wt/vol) brain homogenate derived from a sheep clinically affected with scrapie. A non-inoculated deer was maintained as a negative control. Deer were observed daily for clinical signs of disease and euthanized and necropsied when unequivocal signs of scrapie were noted. One animal died 7 months post inoculation (pi) due to intercurrent disease. Examinations of brain tissue for the presence of the disease-associated abnormal prion protein (PrP^{Sc}) by western blot (WB) and immunohistochemistry (IHC) were

negative whereas IHC of lymphoid tissues was positive. Deer necropsied at 15-22 months pi were positive for scrapie by IHC and WB. Deer necropsied after 20 months pi had clinical signs of depression and progressive weight loss. Tissues with PrP^{Sc} immunoreactivity included brain (at levels of cerebrum, hippocampus, colliculus, cerebellum, and brainstem), trigeminal ganglion, neurohypophysis, retina, spinal cord, and various lymphoid tissues including tonsil, retropharyngeal and mesenteric lymph nodes, Peyer's patches, and spleen. This work demonstrates for the first time that white-tailed deer are susceptible to sheep scrapie by intracerebral inoculation. To further test the susceptibility of white-tailed deer to scrapie these experiments will be repeated with a more natural route of inoculation.

<http://www.veterinaryresearch.org/content/42/1/107/abstract>

Modeling Routes of Chronic Wasting Disease Transmission: Environmental Prion Persistence Promotes Deer Population Decline and Extinction

Emily S. AlMBERG, Paul C. Cross, Christopher J. Johnson, Dennis M. Heisey, Bryan J. Richards
PLoS ONE 6(5): e19896. doi:10.1371/journal.pone.0019896

Abstract:

Chronic wasting disease (CWD) is a fatal disease of deer, elk, and moose transmitted through direct, animal-to-animal contact, and indirectly, via environmental contamination. Considerable attention has been paid to modeling direct transmission, but despite the fact that CWD prions can remain infectious in the environment for years, relatively little information exists about the potential effects of indirect transmission on CWD dynamics. In the present study, we use simulation models to demonstrate how indirect transmission and the duration of environmental prion persistence may affect epidemics of CWD and populations of North American deer. Existing data from Colorado, Wyoming, and Wisconsin's CWD epidemics were used to define plausible short-term outcomes and associated parameter spaces. Resulting long-term outcomes range from relatively low disease prevalence and limited host-population decline to host-population collapse and extinction. Our models suggest that disease prevalence and the severity of population decline is driven by the duration that prions remain infectious in the environment. Despite relatively low epidemic growth rates, the basic reproductive number, R_0 , may be much larger than expected under the direct-transmission paradigm because the infectious period can vastly exceed the host's life span. High prion persistence is expected to lead to an increasing environmental pool of prions during the early phases (i.e. approximately during the first 50 years) of the epidemic. As a consequence, over this period of time, disease dynamics will become more heavily influenced by indirect transmission, which may explain some of the observed regional differences in age and sex-specific disease patterns. This suggests management interventions, such as culling or vaccination, will become increasingly less effective as CWD epidemics progress.

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0019896>

Broad and fine-scale genetic analysis of white-tailed deer populations: estimating the relative risk of chronic wasting disease spread

Catherine I. Cullingham, Evelyn H. Merrill, Margo J. Pybus, Trent K. Bollinger, Gregory A. Wilson, David W. Coltman

Abstract:

Chronic wasting disease is a transmissible spongiform encephalopathy of cervids, similar to sheep scrapie that has only recently been detected in wild populations of white-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus hemionus*) in western Canada. Relatively little is known about local transmission dynamics of the disease or the potential for long-distance spread. We analysed the population genetic structure of over 2000 white-tailed deer sampled from Alberta, British Columbia, and Saskatchewan using microsatellite profiles and mtDNA sequencing to assess the relative risk of disease spread. There was very little differentiation among subpopulations and a weak trend of increasing differentiation with geographic distance. This suggests that the potential for long-distance disease spread through the dispersal of infected individuals is possible, yet the risk of spread should gradually diminish with distance from infection foci. Within subpopulations, females were more related than expected by chance ($R > 0$) within a radius of approximately 500 m. Sex-biased philopatry and social interactions among related females may facilitate local disease transmission within social groups. Local herd reduction may therefore be an effective tool for reducing the disease prevalence when implemented at the appropriate spatial scale.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1752-4571.2010.00142.x/abstract>