Chronic Wasting Disease

USDA APHIS VS Careers Program
Program Diseases Training Module

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January 2004
Revised August 2004
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This course is designed to provide updated information on the major domestic diseases for which Veterinary Services (VS) has program responsibility. It will provide information on surveillance, disease control and eradication for these diseases. It will also give an overview of the duties of a field Veterinary Medical Officer (VMO) as a support worker of VS animal disease programs and how they interact with other units in APHIS.

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1. DISEASE INFORMATION

a. Agent
Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy (TSE) that affects deer and elk.\textsuperscript{1-3} The agent responsible for CWD (and other animal TSEs, such as scrapie and bovine spongiform encephalopathy) has not been completely characterized. The prevailing theory is that the agent is a prion, an abnormal form of a normal protein (known as cellular prion protein), found most commonly in the central nervous system. The abnormal prion protein “infects” the host animal by promoting conversion of normal cellular prion protein to the abnormal form. [Alternate hypotheses are that the agent is an unconventional virus or a virino.\textsuperscript{2}] Prions accumulate in the brain and lymphoid tissues and are thought to contribute to vacuolization of the brain (“spongiform” morphology), cell death, and degeneration of normal mental function.\textsuperscript{3,4} The result is a slowly progressive, fatal neurodegenerative disease.

CWD is only known to affect cervids (members of the deer family). This disease has been seen in Rocky Mountain elk, mule deer, white-tailed deer, and black-tailed deer.\textsuperscript{2,3,5} Because red deer are genetically very similar to elk, it is thought that they are probably susceptible as well.\textsuperscript{5} Many other species, including moose, domestic sheep and goats, cattle, pronghorn antelope, bighorn sheep, mountain goats, bison, and rodents, remain uninfected even when exposed to infected deer and elk.\textsuperscript{2,8} Experimental infections have been established in mice, ferrets, mink, goats, squirrel monkeys, and calves by intracerebral inoculation but not by natural routes of exposure.\textsuperscript{6} There is no known relationship between CWD and any other TSE of animals or people.\textsuperscript{7}

Based on experience with other TSEs, the CWD prion is expected to be resistant to heat, pH changes, ultraviolet irradiation, and normal disinfection procedures.\textsuperscript{1-3} However, strong sodium hypochlorite and sodium hydroxide solutions are effective against prions.\textsuperscript{1} Recommendations for the disinfection of infected premises are still in development.\textsuperscript{3}

b. Transmission
The route of transmission is still unknown. Epidemiologic evidence suggests that this disease is transmitted laterally, from animal to animal.\textsuperscript{1-3,8} It is thought that CWD can be transmitted through nose-to-nose contact (Jayme Patrick, personal communication). It also appears that CWD can also be spread indirectly through the environment; contaminated pastures seem to be the source of exposure in some outbreaks.\textsuperscript{1,3,8-10} Vertical transmission may occur, but does not seem to be important in maintaining epidemics and cannot explain many cases.\textsuperscript{2,9}

The tissue distribution of CWD prions in body tissues still not fully known. Late in the disease, these prions are found in the brain and lymphoid tissues.\textsuperscript{11} Little is known about their distribution early in infection; however, they have been found in the lymphoid tissues of the digestive tract, suggesting that animals might shed CWD prions before the symptoms develop.\textsuperscript{1,3,11,12}

c. Clinical signs
Most cases of CWD occur in adult animals. The disease is progressive and always fatal. Animals with CWD may be asymptomatic for years. In experimentally infected animals, the minimum incubation period varies from 12 to 22 months.\textsuperscript{1,13} In herds in CWD endemic areas, clinical CWD cases have appeared at 13 to 58 month intervals.\textsuperscript{13} Both the incubation period and the disease course seem to be dose-dependent.\textsuperscript{13}
The characteristic symptom is chronic, progressive weight loss. Affected animals may have a reduced appetite for hay, but continue to eat grain. Most animals also develop behavioral changes, including decreased interactions with other animals and listlessness. Affected animals may have a lowered head, a “blank” facial expression, drooping ears, and may stumble or walk repetitively in set patterns. In elk, behavioral changes may also include hyperexcitability and nervousness. Excessive salivation and teeth grinding are also observed. Most deer show increased drinking and urination. Infected animals usually die in a few weeks to several months, but some experimentally infected elk have survived for at least three and a half years after the onset of clinical signs.

d. Epidemiology

Animals born in captivity and those born in the wild have been affected with the disease. CWD can be introduced into a population either in infected animals or by contact with a contaminated environment. Because CWD prions have been found in the intestinal lymphoid tissues early in infection, they might be shed from asymptomatic animals. The disease is probably spread through nose-to-nose contact. There is no evidence that it is a food-borne illness like bovine spongiform encephalopathy (BSE). Vertical transmission does not seem to be important in sustaining epidemics.

In the wild, models and epidemiologic observations suggest that chronic wasting disease may spread along natural migration corridors. It can be maintained in a population even when the population density is moderate to low. In captive herds and in artificially concentrated wild populations (such as those gathered at semi-permanent bait stations), the prevalence of infection can be very high and may increase quickly. A single captive herd may spread the disease widely because animals are bought, sold, and moved frequently in the captive cervid industry. For example, in Canada, 38 elk herds were traced to a single source.

Mule deer seem to be the primary hosts. The prevalence of infection is relatively high in this species; up to 15% of the animals may become infected in localized populations in the wild and nearly all of the herd members may be infected in a captive herd. The disease dynamics are probably similar in white-tailed deer. Rocky Mountain elk may be less susceptible; less than 1% of wild elk are infected in endemic regions, although more than 75% of the animals can be infected in a captive herd. White-tailed deer, mule deer, and elk can spread the disease to each other.

To date, natural infections seem to be limited to cervids. A variety of species, (including rodents, moose, domestic sheep and goats, cattle, pronghorn antelope, bighorn sheep, mountain goats, and bison) have remained uninfected after exposure to infected cervids. Experimental infection of cattle by the oral route has also been unsuccessful. Like other prions, the CWD agent may be able to jump species more freely once it infects another species. For example, Syrian hamsters cannot be infected by intracerebral inoculation with CWD material from cervids, they can be infected after the prion has been passed through ferrets.

The effects of CWD on a population are unknown. Models and observations of captive deer suggest that it is unlikely to coexist stably within a population, and uncontrolled epidemics may result in some localized extinctions. One computer model from the University of Wisconsin suggests that unchecked CWD could cause a deer population to collapse in 20 years.
e. Diagnosis
CWD is usually diagnosed at necropsy, based on microscopic lesions and/or immunohistochemistry.\textsuperscript{2,3} Emaciation is the primary lesion.\textsuperscript{2} There may also be pulmonary lesions if aspiration pneumonia was the cause of death.\textsuperscript{2} The typical microscopic lesions, found in the central nervous system, are spongiform changes that resemble those of other TSEs.\textsuperscript{2}

The official test for surveillance is immunohistochemistry for prion proteins in the brain or lymphoid tissues.\textsuperscript{3} Testing must be done by the National Veterinary Services Laboratories (NVSL) or by a state or university laboratory authorized by NVSL.\textsuperscript{3} Brain tissue samples should contain the obex portion of the brainstem. This is the region of the brain where prion proteins are usually found first and in the most abundance.\textsuperscript{3} In mule deer and white-tailed deer but not elk, the tonsils and retropharyngeal lymph nodes often become positive before the obex, so they are valuable for surveillance testing as well (Jayme Patrick, personal communication).\textsuperscript{3} A live animal test (immunohistochemistry on tonsil biopsies) has been developed for surveillance in wild mule deer and white-tailed deer populations.\textsuperscript{3,12} This test can be used in limited circumstances. This test is not useful in elk; in this species, prions do not accumulate in the lymphoid tissues until later in the course of the disease.\textsuperscript{12}

Since spring 2003, the USDA has approved several ELISA test kits to detect prions in the lymphoid tissues (Jayme Patrick, personal communication).\textsuperscript{1} These tests are used for surveillance in wild deer and elk, but have not been approved for farmed cervid regulatory programs.\textsuperscript{1}

The current tests are approved for disease surveillance and are not considered to be food safety tests.\textsuperscript{15} No test can guarantee that an animal is disease-free or safe to eat, given the long incubation period, the uncertainty about the location of the agent early in infection, and the high false negative rate in asymptomatic animals.\textsuperscript{3,11}

f. Prevention and control
No treatments or vaccines are available; therefore, chronic wasting disease can only be controlled by prevention or eradication.\textsuperscript{3,10} In uninfected areas, it may be possible to prevent infection in wild cervids by movement restrictions, restrictions on baiting and feeding, and population management.\textsuperscript{10} Because of the long incubation time of this disease, infected herds may be found only after long-term surveillance. In captive elk herds in Colorado and Nebraska, the first cases were detected 16 to 40 months after surveillance programs were started.\textsuperscript{13} The VS Herd Certification Program requires a 60-month in captive elk. Many states also use a 60-month surveillance period.\textsuperscript{13}

Environmental contamination is a major risk factor for this disease.\textsuperscript{1} Little is known about the most effective means of disinfection, or whether an environment can be completely disinfected.\textsuperscript{1,3} To prevent re-infection in zoos, the American Association of Zoo Veterinarians (AAZV) recommends that cervids not be re-introduced to contaminated facilities for at least 5 years.\textsuperscript{1} In the wild, habitat modification might keep animals from using contaminated areas.\textsuperscript{10} The uncertainties about disinfection and transmission methods also complicate carcass disposal. CWD-positive carcasses are currently handled by incineration, tissue digestion, or burial using an engineered landfill.\textsuperscript{1}
A variety of techniques have been used in attempts to manage the disease in wild cervids. Depopulation can eradicate CWD from farmed cervids or wild cervids in limited geographical areas. In wild populations, elimination is most feasible for new foci of infection. Reductions in population density can be used to control transmission in wild populations, either when the disease is already present or as a preventative measure. Specific subsets of animals, such as yearling males expected to disperse from the area, may be targeted for depopulation. Test and removal may be appropriate in some situations. If eradication is impossible, such as in endemic areas where the disease has existed for decades, the goal is to keep the prevalence of infection low and limit its geographic area. Several agencies are using a variety of techniques for managing CWD, however standardized management methods have not yet established (Jayme Patrick, personal communication).

g. Relationship of chronic wasting disease and other TSEs
There is no known relationship between CWD and any other TSE of animals or humans.

h. Public health consequences
There is no evidence, to date, that CWD can be transmitted to humans. Although there was some speculation that this disease may have been responsible for neurologic disease in three unusually young patients who had eaten venison, the Centers for Disease Control and Prevention (CDC) found no epidemiologic link or evidence of CWD prions in these men. There is, however, no strong evidence that transmission to humans would be impossible; therefore, the CDC suggests that consumers should avoid eating any food from an animal with a known TSE. Some researchers warn that human exposure to CWD has been so limited that a case is unlikely even if CWD can jump species barriers. Further epidemiologic and laboratory studies, including molecular characterization and strain typing, may be necessary to rule out the possibility of zoonotic spread.

i. Human precautions
Precautions for hunters, wildlife biologists, pathologists and others involved with wild or farmed cervids includes the following:

- Avoid eating meat from any deer or elk that looks sick or behaves abnormally. Hunters should not shoot or handle such animals.
- Wear gloves when field dressing carcasses or performing necropsies, then wash hands and instruments thoroughly.
- When hunting cervids, bone out the meat. Avoid sawing through the bones or cutting through the brain and spinal cord.
- Handle the brain and spinal tissues as little as possible.
- Avoid eating the brain, spinal cord, eyes, spleen, tonsils, or lymph nodes from cervids.
- Avoid eating any animal that tests positive for chronic wasting disease.
- If a deer or elk is processed commercially, request that it be processed separately from other animals.

j. Economic impact
Chronic wasting disease is expected to have its greatest impact on hunting and game management. Hunters are estimated to contribute nearly $20 billion to the U.S. economy. If hunting decreases, some states fear economic losses from fewer hunting licenses and reduced controls on deer populations. Some states are also considering drastic reductions in animal
density as a preventative or control measure. This could also result in economic losses from hunting and hunter-supported businesses.

One study of the potential economic impact of CWD, by Richard Bishop of the University of Wisconsin-Madison, suggests that most of the losses in this state will be borne by hunters and hunting-related businesses. Assuming a net decrease in hunting of 10-20%, Wisconsin hunters are expected to lose between $70-100 million in economic benefits, an average loss of $123-190 per hunter in a season. Bishop expects Wisconsin hunters to spend the lost revenues in other areas, resulting in a minimal overall impact on the state's economy.

State wildlife management agencies, the agencies responsible for CWD surveillance in wild deer, have also been affected. In some cases, funds must be obtained for surveillance by redirecting them from other wildlife management programs. In Wisconsin, roughly 80% of the state budget for game management is now used for CWD surveillance, control, public education, and related activities.

2. HISTORY OF CWD AND ITS CONTROL PROGRAMS

The origins of chronic wasting disease are unknown. First recognized in 1967 as a clinical "wasting" syndrome in mule deer at a wildlife research facility in northern Colorado, CWD was identified as a TSE in 1978. Shortly after this discovery, Colorado and Wyoming wildlife management agencies banned the movement of deer and elk from their research facilities.

In the mid-1980's, CWD was detected in free ranging deer and elk in contiguous portions of northeastern Colorado and southeastern Wyoming. In May 2001, it was also found in free ranging deer in an adjacent area of southwestern Nebraska and later western Nebraska. This contiguous region in Colorado, Wyoming, and Nebraska is called the endemic region. Within this area, 4.7% of mule deer, 2% of white-tailed deer, and 0.5% of elk are positive overall, although there are "hot spots" where up to 15% of the mule deer and up to 16% of the white-tailed deer are infected.

In northeastern Colorado, chronic wasting disease seems to have slowly become more prevalent among mule deer. While the prevalence of infection does not seem to have increased in Wyoming, the disease appears to be expanding its range within the state. Infected wild deer have also been found in western Colorado, Illinois, Nebraska, New Mexico, South Dakota, Utah, Wisconsin, Wyoming and Saskatchewan. Little is known about the disease prevalence in the other states.

The first CWD-positive farmed elk herd in the United States was detected in 1997 in South Dakota. Since then, infected captive elk and deer herds have been found in Colorado, Kansas, Minnesota, Montana, Nebraska, Oklahoma, South Dakota, Wisconsin, and the Canadian provinces of Alberta and Saskatchewan. The disease appears to have spread to Canada in 1989, in captive elk imported from South Dakota, but went unrecognized for a decade.
Chronic wasting disease was also seen outside North America, in a farmed elk imported in 1997 from Saskatchewan to South Korea. The Korean outbreak may have been limited, as other cervids that had been in contact with this animal were euthanized and found to be negative.

Until the 1990s, interest in CWD was limited. However, the discovery of bovine spongiform encephalopathy (BSE) and variant Creutzfeldt-Jakob disease (vCJD) in the United Kingdom increased concerns about TSEs. In the late 1990s, the U.S. and Canada began enhanced surveillance for chronic wasting disease.

In 1998 and 1999, the U.S. Animal Health Association (USAHA) passed resolutions endorsing the development of a CWD program. An initial program design was put forward by the North American Elk Breeders Association and others. A proposal resulted in 1999 from a series of discussions and reviews with State and Federal agriculture and wildlife agencies, State and Federal university diagnostic laboratories and research institutions, and deer and elk industry associations. Producer associations included the North American Elk Breeders Association, the Exotic Wildlife Association, the American Sheep Institute, and the North American Deer Farmers Association.

In October 2000, USAHA endorsed the continued development of an earlier version of this program. Informal comments on that program were received from a number of organizations and individuals through the end of 2000. Existing State CWD programs were reviewed. Following a final meeting of APHIS representatives, a program proposal was put forward as the basis for a cooperative national CWD program.

In 2001, the USDA first received funding to begin eradicating CWD in farmed elk and deer. The funds allow APHIS to conduct surveillance and purchase and euthanized infected and exposed animals. In the U.S., as of June 2004, 4 of 32 positive herds remain under State quarantine. Twenty-seven of the herds were depopulated or slaughtered and tested. The quarantine was lifted from one herd that underwent rigorous surveillance with no further evidence of disease (Jayme Patrick, personal communication). All of the Canadian herds, have been depopulated.

In 2002, a task force from USDA, the U.S. Department of the Interior, state agriculture and natural resources departments, and the farmed cervid industry developed a plan for disease management, research, surveillance, and information dissemination. A national certification program for farmed cervids was presented to Congress in June 2002, is undergoing final review, and is expected to be implemented in 2004. APHIS and the states have also increased surveillance in wild cervids; more than 90,000 samples were collected throughout the U.S. during the 2002-2003 hunting season.

Wild cervids are no longer shipped from the endemic region. State control measures have also included disease surveillance programs, removal of suspect animals, public education, and research. For many years, these measures appeared to be successful, as cases of CWD were not reported outside the endemic area.
3. CURRENT CONTROL PROGRAM

a. State response
The primary responsibility for controlling CWD belongs to the states and provinces.\textsuperscript{16} Most states have established CWD surveillance and/or herd certification programs.\textsuperscript{2,10,25,26} In addition, some states are managing wild deer to eradicate chronic wasting disease or prevent its introduction.

Additionally, many states have changed the importation requirements for cervids to specifically address CWD and prohibit importation of cervids from affected states, require that cervids come from states with official monitoring and certification programs, and/or prohibit the importation of infected animals and animals from infected herds.\textsuperscript{10} Some states have banned all cervid imports.\textsuperscript{10}

Both Colorado and Wisconsin are experimenting with aggressive culling programs to reduce the population density of deer in areas where the disease has been found.\textsuperscript{16,27} South Dakota is reducing deer densities along the Nebraska border, where its first case of chronic wasting disease was seen in 2001.\textsuperscript{28} Kansas has also increased surveillance and reduced wild herd densities in some areas.\textsuperscript{29}

States receive support from a variety of federal agencies, including USDA-APHIS, the National Park Service, Forest Service, U.S. Geological Survey, Bureau of Land Management (BLM), and Bureau of Indian Affairs (BIA).\textsuperscript{16}

b. APHIS-VS response
The goals of CWD management includes controlling and eventually eradicating CWD from farmed cervid herds in order to assist the cervid industry and assure our trading partners of the safety of U.S. agricultural products.\textsuperscript{10} APHIS-VS cooperates with state agriculture and wildlife agencies in surveillance and eradication programs for farmed cervids.\textsuperscript{2} APHIS-VS also encourages elk and deer farmers to enroll in these state programs, and to buy animals only from herds enrolled in control programs or otherwise known not to be infected.\textsuperscript{3}

APHIS-VS tests captive cervids without charge to the state or herd owner.\textsuperscript{25} Positive herds are quarantined by the individual states.\textsuperscript{2,3} If the owner agrees, APHIS-VS offers indemnity and pays disposal and testing costs to depopulate positive and exposed captive herds, as well as trace animals from positive herds. Indemnity is figured at 95% of appraised market value and is capped at $3,000 per animal.\textsuperscript{2,3,7} APHIS-VS continues to pay laboratory costs for all surveillance testing of captive cervids.

If the producer chooses not to participate in this plan, the herd remains under state quarantine with strict movement restrictions.\textsuperscript{2} APHIS-VS will also buy and depopulate farmed elk herds in the endemic region of Colorado, if the herd owner agrees to restock with only non-cervid livestock.\textsuperscript{2} In addition, APHIS-VS has proposed a Federal/State/industry certification program for farmed elk and deer.\textsuperscript{3}

APHIS-VS also assists states with surveillance and diagnostics in wild elk and deer populations.\textsuperscript{3,17} All states can submit tissues from symptomatic wild cervids for free testing.\textsuperscript{17} All states can also submit samples collected during active surveillance of asymptomatic deer.\textsuperscript{17} In
2003, APHIS-VS completed funding to all 50 State wildlife agencies to provide assistance for CWD surveillance and management in free-ranging deer and elk. Total funding was $4 million covering testing costs for more than 90,000 hunter-harvested surveillance samples nationwide. APHIS also provided $500,000 in CWD assistance to Native American tribes to hire regional tribal biologists and to assist individual tribes with CWD activities. 

c. CWD herd certification program for farmed cervids
The APHIS Herd Certification Program (HCP) is a joint federal, state, and industry program for farmed elk, white tailed deer, mule deer, and red deer. It is undergoing final regulatory review and is expected to begin in 2004. The USDA program is similar to certification programs that are already established in approximately twenty states and will incorporate existing state programs that meet or exceed the national program standards. Once the program has begun, captive cervid owners will be able to participate either in their approved state program or in the national program if no approved state program exists.

The requirements for participating herds will include fencing, identification of individual animals, regular inventories of the herd, and testing of any animal more than 16 months old that dies or is killed for any reason. Participation in the program will be required to move animals interstate. Herds with no positive animals will advance in status, with fewer movement restrictions, after completing each year in the program. herd additions must be from herds with the same or a higher status. After five years with no evidence of disease, the herd will be certified to be at a low risk for chronic wasting disease.

Herds with CWD-positive animals and exposed herds will be required to have herd management plans. Positive herds will be depopulated, with indemnity, or quarantined, and the movements of animals to and from the herd will be investigated. Trace-forward animals will be euthanized and tested. If this is not possible, the trace-forward herd will be quarantined and put under surveillance. Trace-back herds will be quarantined. If positive animals are identified by surveillance or testing, the trace-forward and trace-back herds will be depopulated or quarantined.

4. CONTROL PROGRAM STATUS

a. Testing
Immunohistochemistry is the official test for surveillance. Samples should be taken by trained collectors, not captive cervid owners or the general hunting public. Testing must be done by the National Veterinary Services Laboratories (NVSL) or a state or university laboratory authorized by NVSL. A total of 26 laboratories are included in this network. A variety of high throughput assays are currently being developed or validated.

In spring 2003, the USDA approved two ELISA test kits for lymph node tissues from deer and elk. A third test kit was licensed in fall 2003 (Jayme Patrick, personal communication). These tests are used for surveillance in wild cervids, but have not been approved for farmed cervid regulatory programs. No test has yet been officially approved for antemortem testing.
b. Surveillance

Surveillance is necessary to establish the prevalence and distribution of chronic wasting disease, and assess management actions.\(^{10}\) Due to the relatively low prevalence of infection in wild cervids, large sample sizes may be needed before CWD-positive animals are found or negative results can be considered to be reliable.\(^{17}\) Long-term surveillance, over several years, may be necessary.\(^{13}\)

Surveillance in captive cervids has gradually increased since 1997; while only 115 samples were tested in 1998, over 12,000 were tested in 2003.\(^{2}\) The three major approaches used by states and agencies, in varying combinations, are targeted surveillance, hunter-harvest surveillance, and mortality-based surveillance.\(^{31}\)

1) **Targeted (passive) surveillance.** In targeted (passive) surveillance, any cervid older than 18 months is tested if it has symptoms consistent with CWD.\(^{10,31}\) This method can find new foci of infection in both wild and captive herds.\(^{31}\) Although targeted surveillance is efficient and economical, symptomatic animals are not usually found until the prevalence rate approaches 1%.\(^{17}\) In wildlife, the effectiveness of this approach also varies with the amount of human activity in the area and the level of concern about the disease.\(^{17}\) Targeted surveillance has identified infected wild cervids in Colorado, Illinois, Nebraska, New Mexico, and Wyoming.\(^{17}\) Targeted surveillance is not useful for estimating disease prevalence.\(^{31}\)

2) **Hunter-harvest (active) surveillance.** Hunter-harvest surveillance is a common form of active surveillance. In this form of surveillance, sections of brainstem, tonsils, or retropharyngeal lymph nodes are collected from deer and elk killed by hunters and tested for chronic wasting disease.\(^{31}\) In other forms of active surveillance, agency personnel may kill specified numbers of cervids for testing.\(^{17}\) Active surveillance is useful for estimating the prevalence of infection and the extent of the infected area.\(^{10,31}\) Hunter-harvest surveillance has detected new foci of infections in Nebraska, Saskatchewan, South Dakota, and Wisconsin.\(^{17}\)

3) **Mortality-based surveillance.** “Mortality-based surveillance,” or testing of dead cervids, is being used in an increasing number of states and provinces and has resulted in the identification of several infected elk farms.\(^{31}\) This form of surveillance is part of the proposed USDA certification program for farmed cervids.\(^{25}\)

In addition, infected herds may be identified by epidemiology. Trace-back and trace-forward investigations are conducted on infected farmed cervids. Epidemiological investigations may also be done on wild cervids that pose a risk to farmed animals or may have been infected by exposure to farmed animals.\(^{10}\)

5. **Roles of Other Agencies, States, and Industry**

Many state and federal agencies are involved in controlling chronic wasting disease.\(^{26}\) The primary responsibility belongs to the states.\(^{16}\) State wildlife management agencies are responsible for wild cervids.\(^{26}\) When wild cervids are held captive for research or other purposes, the overseeing agency may be the state agriculture agency, the state wildlife agency, or both.\(^{26}\) Jurisdiction over farmed cervids varies depending on the state and may be controlled by the State Department of Agriculture (DOA) or its equivalent, the State Department of Fish
and Game, or joint management by both agencies.\textsuperscript{10} State veterinary diagnostic laboratories and universities may also be involved in control efforts.

Federal agencies coordinate CWD control programs and provide assistance to the states with research, surveillance, disease management, diagnostic testing, technology, communication, public education, and funding.\textsuperscript{10} A number of federal agencies in the U.S. Department of the Interior (DOI) and the U.S. Department of Agriculture (USDA) may be involved, including APHIS, Agriculture Research Service (ARS), the National Park Service, Forest Service, U.S. Geological Survey (USGS), BLM, and BIA, as well as NVSL.\textsuperscript{10,16}

APHIS assists states with testing and surveillance programs in both wild and captive cervids.\textsuperscript{17} The National Park Service conducts targeted surveillance of cervids with symptoms of CWD and also tests live deer in parks near confirmed CWD cases.\textsuperscript{1,10} The Department of the Interior works with the states in hunter surveillance programs.\textsuperscript{1,10} In addition, a national CWD database is maintained at the National Wildlife Health Center as part of the National Biological Information Infrastructure (NBII) wildlife health node of the USGS.\textsuperscript{17}

6. REFERENCES


