

# **Bovine Spongiform Encephalopathy: Implications for the United States**

## **A Follow-up**

**April 1996**

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Additional information on bovine spongiform encephalopathy is available through the USDA:APHIS:VS, Centers for Epidemiology and Animal Health; 555 South Howes, Suite 200; Fort Collins, Colorado 80521.

## Bovine Spongiform Encephalopathy: Implications for the United States - A Follow-up

The purpose of this report is to provide an update of 'Bovine Spongiform Encephalopathy: Implications for the United States', dated December 1993. The format is the same as the original. This report contains three articles relating to BSE:

○ **An update on bovine spongiform encephalopathy in Great Britain** ..... Page 1

A series of questions and answers describes BSE in Great Britain; the current status of the epidemic as well as epidemiologic and research findings. Indications are that the July 1988 ban on the feeding of ruminant-derived proteins to ruminants is having the desired effect.

○ **An update of risk factors for BSE in the United States** .....Page 7

Risk factors for BSE in the U.S. were initially proposed by USDA:APHIS:VS in 1990. Changes within each of the risk factors are evaluated. It was concluded that since there was either no change or a decrease in the magnitude of risk factors, the overall risk of BSE in the U.S. has decreased.

○ **A review of BSE surveillance in the United States** ..... Page 13

Components of BSE surveillance in the U.S. are described. The primary component of active surveillance is the histologic examination of cattle brains. It is estimated that, since BSE has not been found in a sample of 2,411 brains examined, the maximum potential prevalence of BSE in the U.S. is between 1.2 per 100,000 and 2.3 per million total adult cattle. Passive surveillance includes the analysis of existing data sources for spatial or temporal patterns. The network of private practitioners who refer unusual cases to veterinary medical schools or State diagnostic laboratories provides an important informal detection system.

# **An Update on Bovine Spongiform Encephalopathy in Great Britain**

**April 1996**

## 1. What is the current status of the BSE epidemic?

- \* Worldwide, there have been over 161,000 laboratory confirmed cases of BSE since the beginning of the epidemic in 1986.
- \* Greater than 99 percent of the cases have occurred in the United Kingdom (England, Scotland, Wales, Northern Ireland, Channel Islands, Isle of Man).
- \* Countries outside of the United Kingdom that have had cases of BSE in domestic cattle are: France, the Republic of Ireland, Portugal, and Switzerland.
- \* Countries that have not had BSE in domestic cattle but have had cases of BSE in cattle imported from the United Kingdom are: Canada, Denmark, Falkland Islands, Germany, Italy, and Oman.

## 2. What is the current status of the BSE epidemic in Great Britain (England, Scotland, Wales)?

- \* About 98 percent of all cases of BSE have occurred in Great Britain.
- \* Fifty-nine (59) percent of all dairy farms and 15 percent of all beef farms have experienced at least one case of BSE.
- \* On affected farms, 36 percent have experienced only one case, 70 percent have experienced four or fewer cases.

## 3. What is the current status of spongiform encephalopathies in other species in the United Kingdom?

- \* Twenty-four (24) confirmed cases in exotic animals (18 in exotic ruminants, 6 in exotic felines) plus 2 cases in exotic felines born in British zoos and exported.
- \* Seventy (70) confirmed cases in domestic cats, no known cases in dogs. There has also been a case in a domestic cat in Norway.
- \* No confirmed cases of spongiform encephalopathies in deer, despite feeding of ruminant-derived rations.
- \* Scrapie continues to be diagnosed in sheep throughout the United Kingdom.

4. Is the BSE epidemic in Great Britain under control?

\* Yes, the number of cases confirmed per month continues to decrease. There are now about 300 new cases each week compared with over 1,000 at the peak of the epidemic.

\* There has been a continued shift in the age profile of the disease, with fewer young animals affected. BSE incidence in animals born since 1988 (when the feed ban was introduced) continues to decrease dramatically, with age-specific incidence now declining in all age groups of 6 years of less. For example, in 6-year old cattle the incidence has decreased from 6.2 percent of animals in herds with homebred cases in 1994 to 3.4 percent in 1995.

5. Has the July 1988 ban on feeding ruminant-derived protein to ruminants reduced the magnitude of the Great Britain epidemic?

\* Yes. The age-specific incidence of BSE in cattle born after the ban is substantially less than the comparable age-specific incidence of BSE in cattle born before the ban.

\* The imposition of the feed ban is estimated to have prevented at least 150,000 cases.

\* As of November 1995, there were 23,148 confirmed cases in cattle born after the feed ban.

\* A total of 20,185 of these cases occurred in cattle born in 1988 or 1989. This lends credence to the idea that most of the cases born after the feed ban are due to infected feed that remained in the supply chain or on farms after the ban.

\* Because of obvious compliance problems with the July 1988 feed ban, the regulation was extended in 1990 to ban the use of ruminant-derived protein in any animal or bird feed. Additional actions were taken to preclude accidental exposure of cattle to ruminant-derived protein.

\* The ban was further extended in November 1994, prohibiting the use of all mammalian protein in ruminant feed.

6. Will the diagnostic approaches or case management change as the epidemic subsides in GB?

\* As the number of BSE cases declines, the relative proportion of suspect cattle without BSE will increase. To date, about 15 percent of BSE suspects are unconfirmed upon laboratory examination. Research to improve clinical diagnosis is ongoing, in order to reduce the number of suspects slaughtered unnecessarily.

- \* Veterinary officers are required to visit all BSE suspects born after the feed ban of July 1988 to rule out other diagnoses and to investigate possible sources of infection.

- \* Alternative ante- and post-mortem diagnostic approaches continue to be evaluated. To date, there have been no major breakthroughs.

7. Have the epidemiologic studies generated any new information about BSE transmission?

- \* Observations continue to be consistent with a common-source foodborne epidemic.

- \* A case-control study found no evidence that maternal transmission occurred. Although there was marginally significant evidence of horizontal transmission (cow to cow or to a calf which is not its own offspring), the authors concluded that this mode of transmission was not capable of maintaining the epidemic.

- \* A cohort study designed to further investigate the role of maternal transmission is still underway. This study, to be complete in 1997, includes 315 offspring of confirmed cases and 315 controls.

8. What are the latest results of transmission studies using tissues from BSE-affected cattle?

- \* Under laboratory conditions, oral transmission has been achieved by feeding brain tissue to sheep, goats, mink, mice, and cattle.

- \* The minimum oral infective dose under natural conditions remains unknown.

- \* Tissue from the brain, spinal cord, and retina has proved infectious to mice which were inoculated with tissues from naturally-occurring cases of BSE. A wide range of other tissues have shown no detectable infectivity after inoculation.

- \* Tissue from the distal ileum of calves experimentally dosed with the BSE agent (calves were fed brain tissue from clinical BSE cases) has also been found to be infectious to mice.

- \* No detectable infectivity has been identified after feeding mice with muscle tissues, milk, udder, spleen, placenta, or lymph nodes.

9. How about other studies of BSE underway in Great Britain?

- \* An embryo transfer study, in which embryos from clinical cases of BSE were transferred to recipient cows from New Zealand, is expected to be completed in 2001.

\* An expanded study of transmission through milk is in progress. An earlier, smaller study found that milk and mammary gland was not infective for mice.

\* An experimental study of various rendering methods has so far determined that most methods used in Great Britain and other European Union countries do not inactivate the BSE agent's infectivity. No infectivity was found in tallow from the contaminated material.

\* Research on the molecular level includes studies of the nature of the BSE agent, ways to identify BSE-affected animals from blood or urine, and development of in-vitro systems to study the disease.

10. What have been the BSE disposal, compensation, and research costs in Great Britain?

\* Through July 1995, approximately \$264 million have been spent for compensation and disposal.

\* Approximately \$42 million have been spent on research.

\* Expenditures for office and field support as well as lost domestic and international markets for live animals and cattle-derived products have not been estimated.

11. What is the relationship between BSE and Creutzfeldt-Jakob disease (CJD)?

\* Most experts acknowledge that there is no definitive evidence to either support or refute the theory that CJD can be caused by exposure to BSE.

\* A special CJD Surveillance Unit was established in 1990. Thus, whether or not there is a relationship between BSE and CJD, it is reasonable to expect that improved surveillance and diagnostic techniques could lead to slightly higher rates of CJD diagnosis and to the diagnosis of CJD in age-groups not known to be at risk for the disease.

\* The incidence of CJD in Great Britain has not increased significantly since the onset of BSE, and remains similar to the incidence in other European countries (Incidence per million person years in 1994: France - 0.81; Germany - 0.73; Italy - 0.53; Netherlands - 1.04; Britain - 0.93).

\* Four British dairy farmers have died of CJD in the past 3 years. It was estimated that the probability of observing 4 or more sporadic CJD cases among people who work on British dairy farms is only 0.006. However, over a similar time period, there were 5 cases of CJD in farm workers in France, 2 in Germany, and 3 in Italy. These countries have no or a very low incidence of BSE. In addition, since 1990, no cases of CJD have been reported in abattoir workers, butchers, or veterinary surgeons in the United Kingdom.

12. Is there any evidence that BSE can cause another form of transmissible spongiform encephalopathy in humans?

\* In March 1996, the British Spongiform Encephalopathy Advisory Committee announced that the CJD Surveillance Unit had identified 10 cases of a previously unrecognized and consistent disease pattern. The committee stated, "Although there is no direct evidence of a link, on current data and in the absence of any credible alternative, the most likely explanation at present is that these cases are linked to exposure to BSE before the introduction of the SBO ban in 1989."

\* The clinical features of this disease are largely distinct from those previously seen in CJD. In particular, it differs from CJD in that age of onset is much earlier (all 10 cases were under age 42 vs. generally age 50-75 for CJD) and duration of illness is longer (average of 13 months vs. 3-6 months for CJD). In addition, CJD presents as a rapidly progressive dementia, whereas major signs of this newly-identified variant include anxiety, depression, behavioral changes, followed by incoordination and, late in the clinical course, forgetfulness and memory disturbance. The new variant also does not produce the EEG pattern typical of CJD.

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Answers are based on personal communication with officials from the Ministry of Agriculture, Fisheries, and Food (MAFF), with staff from the Meat and Livestock Commission in Great Britain, with Dr. W. Hueston, USDA:APHIS:VS, and the following references:

Almond, J.W.; Brown, P.; Gore, S. et al. 1995. Creutzfeldt-Jakob disease and bovine spongiform encephalopathy: any connection? *British Medical Journal* 311:1415-1421

Baker, R.F.; Ridley, R.M.; Wells, G.A.H. 1993. Experimental transmission of BSE and scrapie to the common marmoset. *Vet Rec* 132:406

Hoinville, L.J.; Wilesmith, J.W.; Richards, M.S. 1995. An investigation of risk factors for cases of bovine spongiform encephalopathy born after the introduction of the 'feed ban'. *Vet Rec* 136:312-318.

MAFF. 1995. Bovine spongiform encephalopathy in Great Britain - a progress report, November 1995

National Creutzfeldt-Jakob Disease Surveillance Unit. 1996. Letter from R.J. Will to neurologists, dated March 21, 1996.

Richards, M.S; Wilesmith, J.W.; Ryan, J.B.M. et al. 1993. Methods of predicting the incidence of BSE. *Proceedings of the Society of Veterinary Epidemiology and Preventive Medicine*. April 1993

Smith, P.E.M.; Zeidler, M.; Ironside, J.W. et al. 1995. Creutzfeldt-Jakob disease in a dairy farmer. *The Lancet* 346:898



Spongiform Encephalopathy Advisory Committee. 1996. Statement from the Spongiform Encephalopathy Advisory Committee released by the British Ministry of Health on March 20, 1996.

Spongiform Encephalopathy Advisory Committee. 1995. Transmissible spongiform encephalopathies - A summary of present knowledge and research. London: HMSO

'UK to address "lapses" in cattle feed controls for BSE'. 1995. Animal Pharm 330:5

US Food and Drug Administration. International scientific conference on viral safety and evaluation of viral clearance from biopharmaceutical products. June 1995. Bethesda, MD

USDA:APHIS:VS. 1996. DxMonitor. Spring 1996. Centers for Epidemiology and Animal Health. Ft. Collins, CO

Wilesmith, J.W. and Ryan, J.B.M. 1993. Bovine spongiform encephalopathy: observations on the incidence during 1992. Vet Rec 132:300-301

## An Update on Risk Factors for BSE in the United States

### Objective

The purpose of this report is to update the status of risk factors for BSE in the U.S., and to qualitatively evaluate changes in the risk of BSE originally proposed by the U.S. Department of Agriculture, Animal and Plant Health Inspection Services, Veterinary Services (USDA:APHIS:VS) in 1991 (1-3). At that time it was concluded that there was little evidence to support a broad risk for BSE among a large portion of the dairy population of the U.S. Since that assessment was based on data primarily from 1989, information presented in this report will be compared to 1989 data.

### Status of BSE Risk Factors in the U.S.

The Great Britain experience illustrates the need to recognize the potential threat of BSE and to periodically evaluate changes in potential BSE risk factors in the U.S. This evaluation will consider changes within the following risk factors: sheep demographics, scrapie status, sheep slaughter and deaths, rendering and feed manufacturing practices, and use of alternative proteins in calf milk replacers and starter rations. The potential risk from undetected BSE already in the cattle population was not considered.

### Sheep Demographics in the U.S.

A brief overview of the sheep demographics in the U.S. will provide background information and may give insight into some of the factors associated with sheep scrapie. In addition, it serves to illustrate why regional differences exist in the risk of BSE within the U.S., as shown in the 1991 VS document. Breeding sheep 1 year and older in the U.S. totaled 5.56 million on January 1, 1995, down by about 2.44 million from 5 years earlier (4). Western States (North Dakota to Texas and west) had 1.8 million fewer sheep on January 1, 1995, representing a 29 percent decrease. Eastern States' inventory dropped by almost 600,000 head, a 37 percent decrease. Most of the Nation's sheep are still concentrated in the Western States, as they were in 1989 (Figure 1).

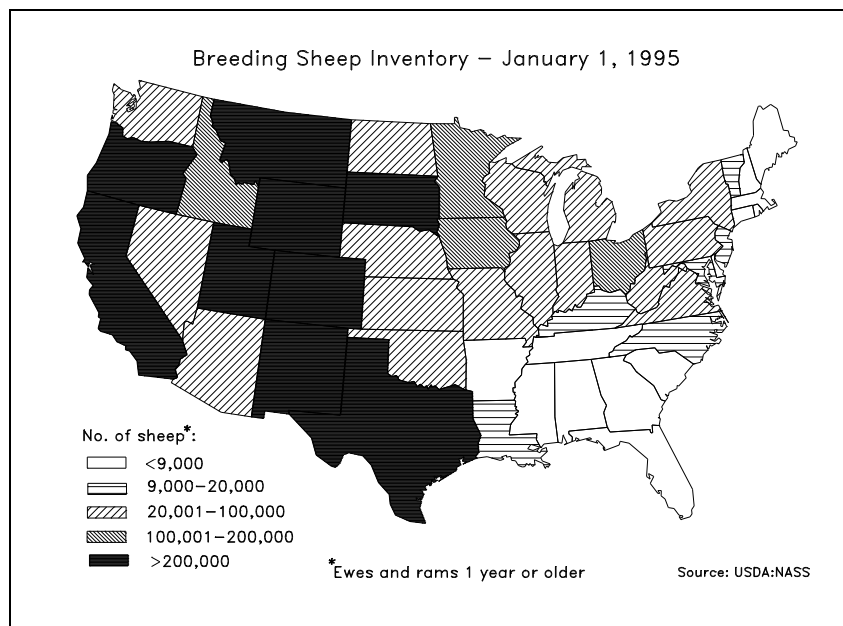


Figure 1

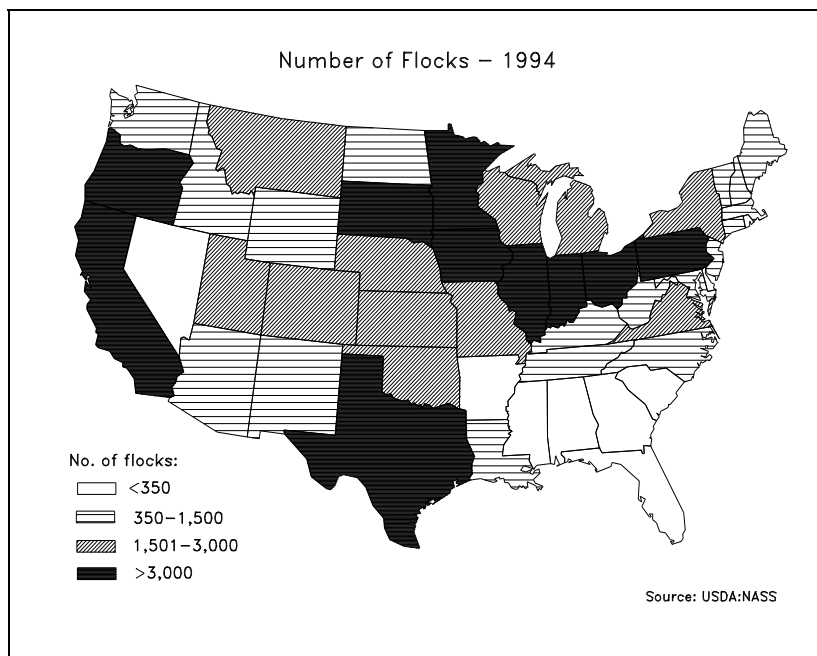


Figure 2

Although Western States have the larger number of sheep, they have fewer flocks than many States in the Central and North Central U.S. (Figure 2). The total number of flocks in 1994, 87,350, was a record low, down 23,700 from 1989. The geographic distribution remained the same.

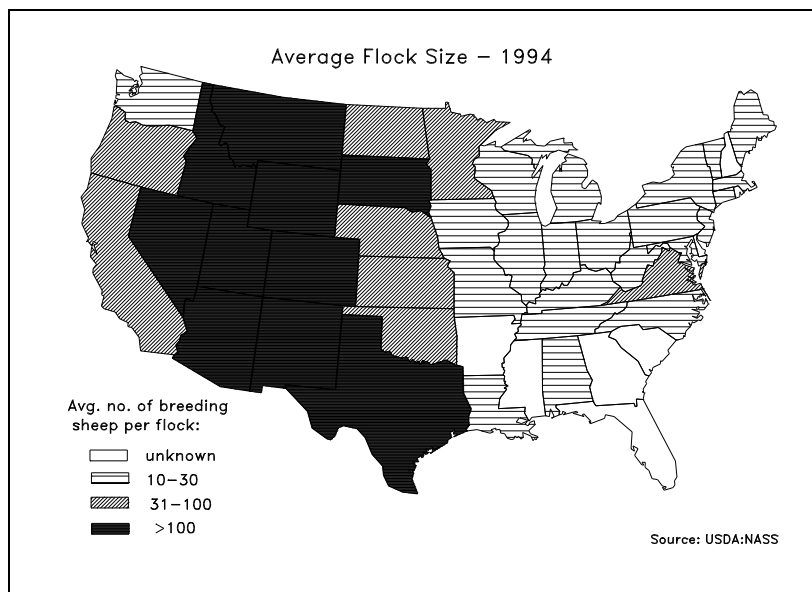


Figure 3

The average number of breeding sheep per flock is high in the Western States and low in the Central and North Central States (Figure 3). This distribution also has not changed since 1989.

Western U.S. had a proportionate decrease in numbers of sheep, it would be expected that broad regional differences in the potential risk of BSE would remain.

The decline in mature sheep inventory between 1989 and 1994 suggests a corresponding decrease in the potential risk for scrapie-induced BSE. This is based on the observation that scrapie is a disease of mature sheep and thus the assumption that lambs do not present a risk of BSE. Since the Eastern and

When evaluating the risk of BSE, it is also important to consider the mature sheep population in relationship to the population of beef and dairy cows. There were 1.73 million more beef and dairy cows in the U.S. at the beginning of 1995 than at the beginning of 1990, representing a 4 percent increase. Due to the 30 percent decline in the mature sheep population, the ratio of mature sheep to beef and dairy cows decreased from 0.18 at the beginning of 1990 to 0.12 at the beginning of 1995. Thus, potential exposure to the scrapie agent would be expected to be reduced.

## Scrapie Status in the U.S.

A total of 37 newly-detected scrapie flocks were reported in 1994, as compared to 50 flocks in 1989 (Figure 4). Due to the drop in total number of flocks, the ratio of newly-reported scrapie flocks to total flocks was about the same in 1994 as in 1989. These numbers underestimate the true level of disease, as scrapie is not required to be reported in all states.

Various programs to eradicate scrapie have existed in the U.S. since 1952 (5). The current Voluntary Flock Certification Program was started October 1, 1992, and relies heavily on an economic incentive. Under this program, a flock can be "certified" if it is scrapie-free for a minimum of 5 years, enhancing the animals' marketability and value. Currently, 177 flocks are part of this voluntary program.

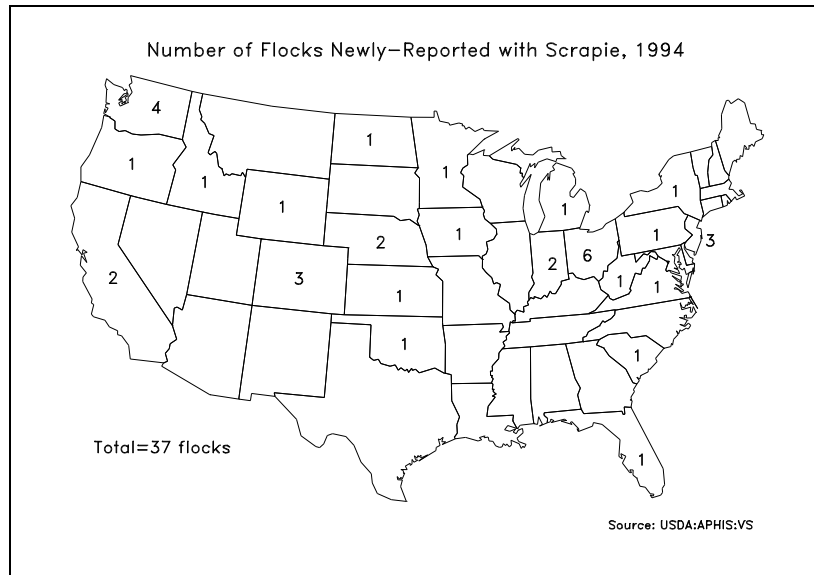


Figure 4

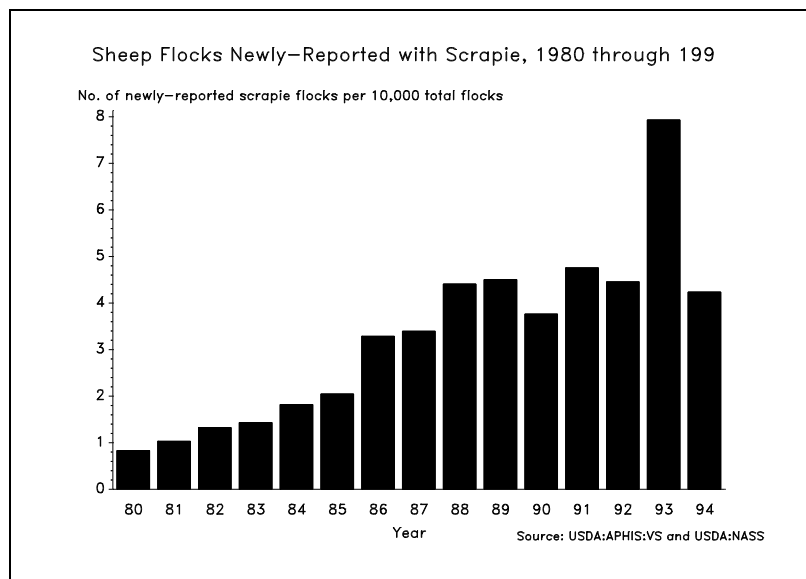


Figure 5

The number of reported flocks has historically varied with the amount of indemnity payment (Figure 5) (2). APHIS stopped indemnity payments for scrapie in 1993. However, a final opportunity for indemnity was made available for total depopulation or depopulation of high-risk animals in infected or source flocks, or for diagnostic sampling to establish flock status. Applications for this indemnity had to be received by July 1993, which may help explain the high proportion of newly-reported flocks in that year.

## Sheep Slaughter and Deaths

To evaluate how the risk of BSE in the U.S. may have changed since the original assessment, it is necessary to consider changes in sheep slaughter and deaths. Total sheep inventory has dropped by almost 2.5 million head since 1989 (Table 1). Most of this decrease was in the category of breeding sheep 1 year and older, suggesting that the downward trend may continue. Further, the number of mature sheep slaughtered in Federally-inspected plants dropped by almost 19 percent. Although there are no direct data, these figures suggest that fewer adult sheep are now going into meat and bone meal, thereby decreasing the potential risk of BSE.

Table 1 Sheep Inventory, Slaughter, and Deaths, 1994 vs. 1989		
	1994	Change from 1989
Total Inventory (Jan. 1, 1995)	8,895,000	-2,472,700
Total Breeding Sheep (1 year and older)	5,562,000	-2,442,500
Federally-inspected Slaughter		
Mature Sheep	288,900	-66,000
Lambs	4,386,200	-385,100
Deaths (all causes)		
Mature Sheep	336,600	-173,400
Lambs <sup>1</sup>	609,400	-125,600

Federally-inspected slaughter from USDA:FSIS; all other figures from USDA:NASS

Five (CA, CO, IA, MN, NM) of the 10 States that slaughtered the most mature sheep in 1989 slaughtered substantially fewer mature sheep in 1994 (Figure 6). The total number of Federally-inspected plants that slaughtered mature sheep decreased by 157 between 1989 and 1994. Most of this decrease was in plants that slaughtered less than 50 sheep per year. Plants that slaughtered 50 or more sheep declined only slightly in number, from 136 in 1989 to 124 in 1994.

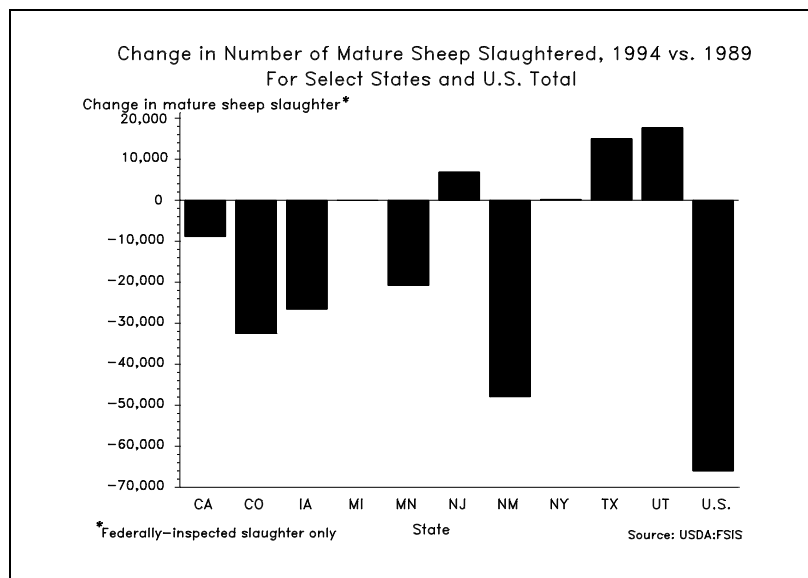


Figure 6

### Rendering and Feed-Manufacturing Practices

Practices in the rendering and feed-manufacturing industries relevant to the risk of cattle contracting BSE were described in the initial BSE update in December 1993 (6,7). At that time, it was concluded that the risk of incorporating the scrapie agent in meat and bone meal decreased substantially between 1985 and 1990. However, factors associated with both industries still allowed for the possibility of the sheep scrapie agent being incorporated in cattle feeds.

In 1989, the National Renderers Association and the Animal Protein Processors Industry suggested that their members voluntarily refrain from rendering adult sheep and selling the rendered product to be used in cattle feed. A limited survey of renderers conducted by the U.S. Food and Drug

<sup>1</sup>Numbers represent deaths after docking (removal of the tail). In 1994, an additional 300,700 lambs died before docking, according to a one-time report issued by NASS.

Administration (FDA) in December of 1992 found that, industry-wide, the voluntary ban appeared to have a high compliance rate. However, some renderers in areas with large numbers of adult sheep slaughter were not fully complying with the ban (8). This led, in August of 1994, to an FDA proposal to prohibit the inclusion of adult sheep and goat offal in ruminant feed.

To date, nothing has developed of the proposed FDA rule. The National Renderers Association continues to remind its members of the importance of the voluntary ban and believes that most responsible renderers are conforming (D. Franco, National Renderers Association, personal communication). Although the possibility of inclusion of scrapie-affected material in cattle feed exists, it appears unlikely that the risk of BSE due to rendering and feed-manufacturing practices is higher at this time than in 1990.

### Alternative Proteins in Calf Milk Replacers and Starter Rations

The 1993 BSE update briefly reviewed available information on the use of alternative proteins in calf milk replacers and starter rations (6). Although it was stated that only muscle-derived protein of bovine or pork origin is sold for commercial use in milk replacers, it is likely that protein from the blood of cattle condemned at slaughter is also used (J Heinrichs, Pennsylvania State Univ., personal communication). However, the conclusion that the risk of U.S. cattle acquiring BSE through calf starter rations or milk replacers is low to negligible appears to stand, since neither muscle nor blood from BSE-affected animals have proved infectious to other animals.

### Summary

Changes in sheep demographics for the U.S. since the initial BSE risk assessment in 1991 have generally been in the direction to lower the risk of BSE. Inventories of breeding sheep 1 year or older were down by 2.44 million from January 1, 1990. Sixty-six thousand (66,000) fewer mature sheep were slaughtered in 1994 than in 1989. The ratio of mature sheep to beef and dairy cows was lower than in 1989.

Table 2 Summary of Risk Factors for BSE in the U.S.: 1994 vs. 1989		
Risk Factor	Change from 1989	BSE Risk Compared to 1989
Mature sheep population	Decrease	Reduction in BSE risk
Ratio of mature sheep to beef & dairy cows	Decrease	Reduction in BSE risk
Scrapie status	Decrease in number of newly-reported flocks	Unknown
Mature sheep slaughter and deaths	Decrease	Reduction in BSE risk
Mature sheep rendering and feed manufacturing	Decrease	Reduction in BSE risk
Protein sources for calf milk replacers and starter rations	None	No change in BSE risk

Overall, there appears to be a lower risk of scrapie-induced BSE in the U.S. today as compared to 1989 (Table 2). However, newly-identified scrapie flocks continue to occur and, since scrapie is not reportable in all states, the prevalence of the disease is unknown. Practices may continue in both the rendering and feed industries which allow for the possibility of sheep scrapie agent being incorporated in ruminant feeds.

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## References

- (1) USDA:APHIS:VS. 1991. Quantitative risk assessment of BSE in the United States.
- (2) USDA:APHIS:VS. 1991. Qualitative analysis of BSE risk factors in the United States.
- (3) Walker, K.D.; Hueston, W.D.; Hurd, H.S. et al. 1991. Comparison of bovine spongiform encephalopathy risk factors in the United States and Great Britain. *J Am Vet Med Assoc* 199:1554-1561.
- (4) USDA, National Agricultural Statistics Service. 1995. Sheep and Goats. Agricultural Statistics Board. Washington, DC.
- (5) USDA:APHIS. February 1991. Proposed Voluntary Scrapie Flock Certification Program.
- (6) USDA:APHIS:VS. 1993. Bovine Spongiform Encephalopathy: Implications for the United States.
- (7) USDA:APHIS:VS. 1993. United States rendering and feed-manufacturing industries: evaluation of practices with risk potential for BSE.
- (8) Honstead, J. 1995. FDA proposes prohibiting sheep and goat offal in ruminant feed. *FDA Veterinarian*. Jan/Feb 1995.

## **A review of BSE Surveillance in the United States**

### **Objective**

The purpose of this report is to provide an update of current surveillance for BSE in the U.S. Surveillance can be divided into two main elements, targeted and general, and these, in turn, are comprised of several components. Targeted, or active, surveillance includes efforts by the U.S. Department of Agriculture (USDA) to distribute educational materials on BSE recognition and diagnosis, to monitor cattle imported from countries with BSE, and to solicit selected cattle brains for histopathologic examination. General, or passive, surveillance is based on data collected primarily by veterinary diagnostic laboratories, veterinary medical schools, and by the Food Safety and Inspection Service (FSIS) and the Animal and Plant Health Inspection Service (APHIS) of the USDA. General surveillance includes field investigations conducted by Federal veterinarians trained in the recognition and diagnosis of foreign animal diseases, and a network of private practitioners who refer unusual cases to veterinary schools and diagnostic laboratories.

### **Targeted Surveillance**

#### **Education**

An important aspect of surveillance is the education of veterinary practitioners to recognize signs of BSE and submit specimens for definitive histopathologic evaluation. To this end, video tapes of cattle showing clinical signs of BSE have been distributed to Federal Area Veterinarians in Charge, State veterinarians, veterinary diagnostic laboratories, and pathology departments of veterinary colleges. Microscope slides showing typical BSE lesions have been sent to veterinary diagnostic and pathology laboratories, and Federal foreign animal disease diagnosticians have travelled to GB for training in BSE recognition. In addition, BSE fact sheets, risk assessments, and reviews have been sent to State and Federal veterinarians, private practitioners, other industries, and to producers (1-4).

Such educational efforts have helped to establish an awareness of the disease by producers. The U.S. beef and dairy industries are characterized by large, intensive operations. In 1994, 52 percent of all dairy cows were located on 14 percent of all dairy farms, and 48 percent of beef cows were located on only 8 percent of all beef operations (5). Such producers tend to keep themselves well-informed about industry-related topics, including diseases such as BSE.

#### **Imported Cattle**

Targeted surveillance also includes the follow-up of 499 cattle which were imported from the United Kingdom between January 1, 1981 and July 1989. In July 1989, the U.S. prohibited the importation of ruminants from countries with BSE. As of October 30, 1995, 117 of the previously imported animals are known to be alive, 339 are known to be dead, 8 animals have been exported, and tracebacks are ongoing for 35 animals (USDA:APHIS:VS, Emergency Programs, personal communication).

The 35 animals of unknown status will continue to be investigated; however, tracebacks on these animals have been difficult due to previous dispersal sales resulting in lost records. APHIS estimates that, based on their ages, only 9 of the 35 cattle of unknown status are still alive. In addition, all of the animals of unknown status would be 8 years or older, thus reducing their likelihood of developing BSE.

Fifty-two (52) of the 117 animals known to be alive came from herds in the United Kingdom in which one or more cases of BSE subsequently developed. VS is currently evaluating options relating to purchase and movement of these animals.



## Examination of Domestic Cattle Brains

A fundamental component of targeted surveillance entails examination of brains from adult domestic cattle with CNS disorders for neuropathologic lesions consistent with BSE. Although the program began in May of 1990, some of the samples dated back to 1986 (6).

As of September 30, 1995, a total of 2,411 brains had been examined by more than 60 veterinary diagnostic laboratories across the U.S. and USDA's National Veterinary Services Laboratories (NVSL). Early in the program, the Centers for Disease Control and Prevention also conducted some of the examinations.

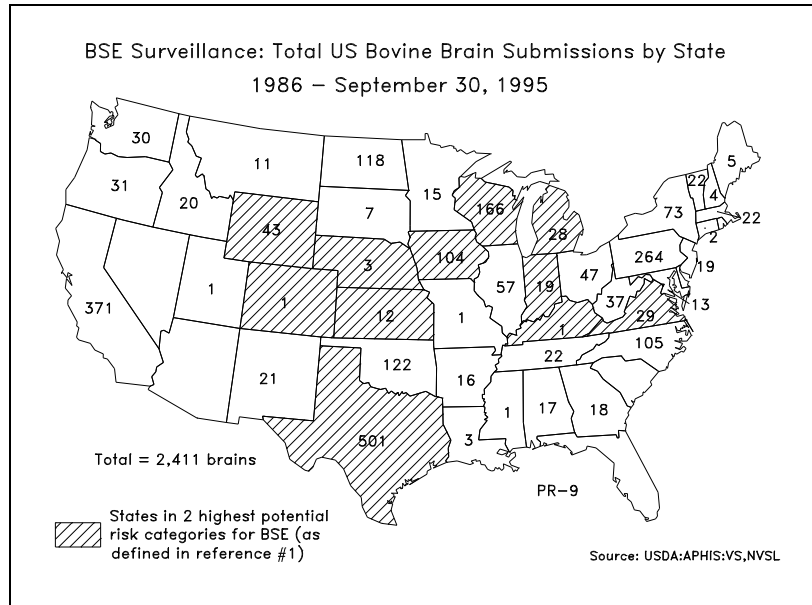


Figure 1

The largest number of specimens have come from Texas, followed by California and Pennsylvania (Figure 1). All brains examined to date have been negative for BSE. Some of the specimens were submitted for rabies diagnosis, found to be negative, and subsequently evaluated for BSE. Not all bovine brains submitted for rabies diagnosis have been examined for BSE lesions. Other cases submitted for examination have come from private practitioners, foreign animal disease investigations, and slaughter plants. Officials from USDA's Food Safety and Inspection Service have been notifying APHIS personnel when cattle at selected slaughter plants show signs of neurologic disorders or are nonambulatory.

### Maximum Potential Prevalence of BSE

The fact that no evidence of BSE has been found in 2,411 cattle brains provides the basis for an estimate of the maximum potential prevalence of BSE in the population of adult cattle in the U.S. The population from which the brains were sampled was adult cattle with clinical or neurologic signs suggestive of CNS disorders in the U.S. The size of this population is not known; however, results from USDA's National Dairy Heifer Evaluation Project were used to estimate that between 25,000 and 130,000 adult cows and bulls (beef and dairy) might be affected with CNS disorders each year. The total number of brains were sampled over a period of several years; however, over the past two years, an average of 645 brains were sampled each year. Using these figures and redefining the population to be all adult cows and bulls, the maximum potential 1-year period prevalence of BSE was estimated to range from 1.2 per 100,000 to 2.3 per million.

### Research Findings Relevant to BSE Surveillance

Most BSE surveillance in the U.S. is based on the presumption that clinical signs and neuropathology would be the same as that seen in GB. Experiments performed in the U.S. showed that calves that were intracerebrally inoculated with U.S.-origin scrapie-infected material in late 1990 developed clinical disease and all have since died. However, clinical signs were different than in GB (cattle became lethargic, then nonambulatory), and histologic examination showed only minor changes unlike those observed in GB. Calves that were fed the scrapie-infected material have shown no clinical disease (R. Cutlip, Agricultural Research Service, personal communication). Although this evidence is not conclusive, it suggests that surveillance for a spongiform encephalopathy in cattle in the U.S. may need to be supplemented. One supplemental test,

based on the prion protein, is currently being used at the NVSL along with histologic examination, primarily in nonambulatory cattle (A. Jenny, National Veterinary Services Laboratories, personal communication).

### BSE Issues Management Team

A BSE Issues Management Team was created in December 1994 to evaluate current information on BSE and potential impacts on human and animal health. The team's function is to actively analyze risks of BSE for the U.S., disseminate accurate information about the disease, and act as a reference source for responding to questions about BSE.

### General Surveillance

#### Practitioner Referrals

The network of private practitioners referring unusual cases to veterinary schools or State diagnostic laboratories around the U.S. provides an extensive informal but important surveillance system. The incentive to detect and promptly report unusual findings is inherent in the competitive academic setting of such institutions, which are independent of the Federal government. Inquiries to several veterinary diagnostic laboratories revealed that anywhere from 26 to almost 100 cattle brains<sup>2</sup> per institution were examined in 1994.

#### Foreign Animal Disease Detection

The USDA conducts many activities to detect and eliminate a foreign animal disease (FAD), such as BSE, if it were introduced. Over 250 State and Federal field veterinarians located throughout the U.S., including Puerto Rico and the U.S. Virgin Islands, have been trained in the recognition and diagnosis of FADs. Channels for reporting FADs have been established for many years. Of 283 investigations of suspected FADs conducted in fiscal year 1994, 58 were of animals with encephalitic disease (7). No evidence of BSE was uncovered.

#### Veterinary School Diagnoses

Another aspect of the general surveillance system makes use of the Veterinary Medical Data Base (VMDB) maintained by Purdue University. This data base contains diagnoses submitted from 27 U.S. veterinary schools, although not all report data every year. Several neurological diagnoses<sup>3</sup> have no underlying etiology and may represent potential BSE cases. There is no evidence to suggest that the rate of these neurological diseases in cattle 2 years of age and older has increased from 1980 through 1994, as would be expected if

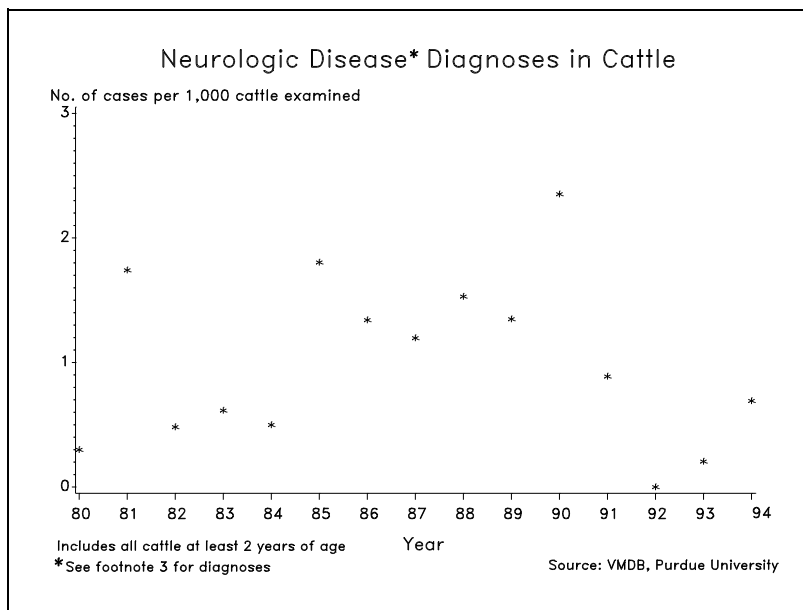


Figure 2

<sup>2</sup> Some institutions reported only adults; some did not identify ages.

<sup>3</sup> Degenerative nervous system; disease of nervous system due to unknown; nervous system, not specifically listed; degenerative axonopathy; encephalomyelitis; encephalomyelitis due to unknown; astrocytosis; disease of central nervous system due to unknown; axonopathy central nervous system; astrocytic swelling; hypertrophic astrocytes; degenerative neuron chromatolysis; encephalitis; encephalitis due to unknown; encephalopathy due to unknown

the U.S. were entering a BSE epidemic (Figure 2). Some of the observed year-to-year variability may be due to inconsistencies in reporting by individual veterinary schools.

### Antemortem Slaughter Inspection

The USDA Food Safety and Inspection Service maintains a data base of all Federally-inspected slaughter establishments, which includes antemortem condemnations due to disorders of the central nervous system. The condemnation rate due to CNS disorders in cows has increased significantly since 1983 ( $p = .0002$ ) (Figure 3). The reasons for this trend are not known, but may include an increased awareness of CNS symptoms, especially following the identification of BSE in GB in 1986.

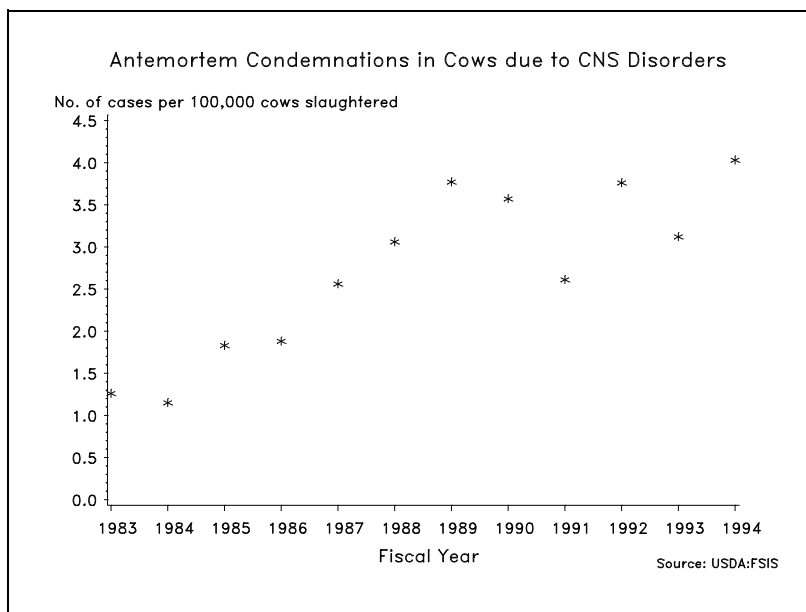


Figure 3

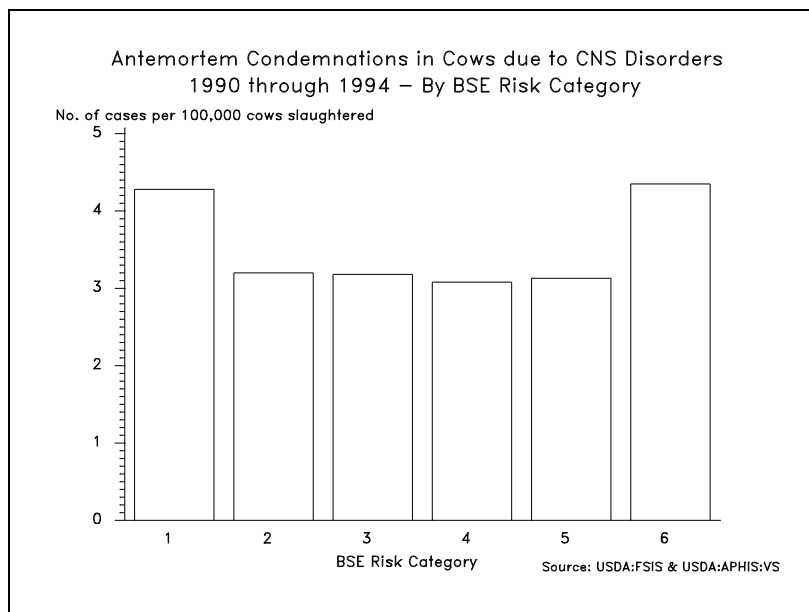


Figure 4

The same data were analyzed by BSE geographic risk categories (highest risk = category 1) as defined in a 1991 report by USDA:APHIS:VS (2) (Figure 4). States potentially at highest risk for BSE have a higher rate of CNS condemnations than do States in all other categories except the lowest risk category. Brain tissue from some cattle with CNS signs received at slaughter plants are examined for BSE and are included in the total number of bovine brain submissions (above).

### Veterinary Diagnostic Laboratory Reporting System

The Veterinary Diagnostic Laboratory Reporting System (VDLRS) is a cooperative effort of the American Association of Veterinary Laboratory Diagnosticians, the U.S. Animal Health Association, and USDA:APHIS:VS' Centers for Epidemiology and Animal Health. Currently 29 State and university veterinary diagnostic laboratories throughout the U.S. report data to the VDLRS on a

variety of diagnostic tests. Although results of histologic examinations for BSE are not reported directly to the VDLRS (indirectly through the NVSL), these laboratories examine hundreds of brains each year and are a likely point of first detection should BSE occur in the U.S. No laboratory submissions suggestive of BSE have been reported.

## **Zoos**

BSE-like illness is not known to exist in U.S. zoos. However, BSE-like encephalopathies have been diagnosed in 7 species of exotic Bovidae at zoos in England. All cases had known or likely dietary exposure to rations containing ruminant-derived meat and bone meal. Initially it was thought that one case in a greater kudu may have occurred as a result of maternal transmission (8,9). However, further investigations revealed that the affected animal could have received contaminated feedstuffs (J. Wilesmith, Central Veterinary Laboratory, MAFF, personal communication). Because the greater kudu, nyala, and gemsbok collections were fed animal protein for only a short period, transmissible spongiform encephalopathy cases in these species appear to have ended.

Eight (8) cases of TSE have also occurred in three species of exotic Felidae. Investigations are still under way in two of the cases. However, all others had exposure to potentially contaminated carcasses.

Veterinary pathologists at the major zoos in the U.S. routinely conduct post-mortem examinations on the brains of cases exhibiting neurologic signs. In addition, all animals that die at major zoos usually undergo necropsy in compliance with guidelines of the American Association of Zoological Parks and Aquariums. A records search conducted by two major zoos showed that no fatal diseases with unexplained clinical signs or presenting signs suggestive of spongiform encephalopathy had occurred since the onset of computerized record keeping in 1964 and 1975, respectively, (W. Heuschele, San Diego Zoological Gardens, and R. Montali, National Zoological Park, personal communication).

## **Summary**

Surveillance for BSE in the U.S. is comprised of many components. Targeted surveillance includes examination of cattle brains by State veterinary diagnostic laboratories and the NVSL. Educational materials distributed by the USDA to diagnostic laboratories and pathology departments in veterinary schools are an often overlooked but important facet of establishing effective surveillance for BSE. Educational efforts have also generated widespread interest in and knowledge of BSE among private veterinary practitioners and producers in the U.S. beef and dairy industries.

Based on what is known of BSE currently, histologic examination of brain specimens from cattle will be most effective when samples are selected from known high-risk groups such as dairy cattle 4 years and older from large herds. Consideration should also be given to the possibility that should a spongiform encephalopathy occur in cattle in the U.S., the neuropathologic and clinical characteristics may not be the same as those seen in GB.

General surveillance takes advantage of already existing data sources. Included in this are data on neurologic diagnoses in cattle from the VMDB (Purdue), CNS antemortem condemnation data from USDA:FSIS, necropsies performed in zoos, and the VDLRS initiative. An added benefit is that these data have been collected for many years and from many sources covering the entire country, allowing for temporal and spatial analyses.

Referral of suspect clinical cases by private practitioners to veterinary teaching hospitals and diagnostic laboratories provides widespread surveillance in the U.S. The importance of this network of clinicians and diagnostic laboratories to detect BSE is critical. Foreign animal disease diagnosticians form an important complement to this network. There has been no reported appearance of a strange, new neurologic disease in cattle, nor does there appear to be an increase in the number of neurologic diagnoses or referrals.

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## References

- (1) USDA:APHIS:VS. 1991. Quantitative risk assessment of BSE in the United States.
- (2) USDA:APHIS:VS. 1991. Qualitative analysis of BSE risk factors in the United States.
- (3) Walker, K.D.; Hueston, W.D.; Hurd, H.S. et al. 1991. Comparison of bovine spongiform encephalopathy risk factors in the United States and Great Britain. *J Am Vet Med Assoc* 199:1554-1561.
- (4) Bleem, A.M.; Crom, R.L; Franczy, B. et al. 1994. Risk factors and surveillance for bovine spongiform encephalopathy in the United States. *J Am Vet Med Assoc* 204:644-651.
- (5) USDA, National Agricultural Statistical Service. February 3, 1995. Cattle. Agricultural Statistics Board. Washington, DC.
- (6) Miller, L.D.; Davis, A.J. and Jenny, A.L. 1992. Surveillance for lesions of bovine spongiform encephalopathy in U.S. cattle. *J Vet Diagn Invest* 4:338-339.
- (7) USDA:APHIS:VS. Winter 1994. Foreign Animal Disease Report.
- (8) Kirkwood, J.K.; Wells, G.A.H.; Wilesmith, J.W. et. al. 1990. Spongiform encephalopathy in an Arabian oryx (*Oryx leucoryx*) and a greater Kudu (*Tragelaphus strepsiceros*). *Vet Rec* 127:418-420.
- (9) Kirkwood, J.K.; Wells, G.A.H.; Cunningham, A.A. et. al. 1992. Scrapie-like encephalopathy in a greater kudu (*Tragelaphus strepsiceros*) which had not been fed ruminant-derived protein. *Vet Rec* 130:365-367.



