sheep image courtesy USDA cow image courtesy Farmphoto.com

# BSE
## Anatomy of A Crisis

Around 180,000 cases of bovine spongiform encephalopathy (BSE), or "mad cow disease," have been confirmed in cattle since it was first identified in 1986 in Great Britain. Making matters worse, in 1996 BSE was linked to an invariably fatal human illness called variant Creutzfeldt-Jakob Disease (vCJD). Understandably, BSE has had a substantial impact on the United Kingdom's livestock industry and altered international trade patterns.

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Though there have been no confirmed cases of BSE or vCJD in the United States, the U.S. has imposed trade restrictions on British beef. In addition, the U.S. has increased spending for BSE surveillance and other measures in order to protect animal and human health. Consumer food safety concerns are also increasing, exacerbated perhaps by the recent foot-and-mouth outbreak in the United Kingdom.

### The Villain of the Piece

BSE is a chronic, degenerative disease affecting the central nervous system of cattle. Infected animals may display changes in temperament such as nervousness or aggression, abnormal posture, lack of coordination and difficulty in rising, decreased milk production, and loss of body condition.

The incubation period usually ranges from two to eight years. Following the onset of symptoms, the animal's condition deteriorates until it dies or is destroyed. This usually takes from two weeks to six months. Most cases in Great Britain have occurred in dairy cows between three and six years of age. At present there is no vaccine or treatment for BSE.

BSE belongs to the family of diseases in other animals and humans known as the transmissible spongiform encephalopathies (TSEs). Brain tissues of infected animals have a sponge-like appearance when examined under a microscope. Other examples of TSEs include scrapie in sheep and goats, transmissible mink encephalopathy, chronic wasting disease in deer and elk, as well as kuru, Creutzfeldt-Jakob Disease (CJD), and—particularly relevant here—a variant of CJD in humans.

Epidemiological data suggest that BSE in Great Britain may have originally been caused by using meat and bone meal made from scrapie-affected sheep, or from cattle with an undiagnosed TSE, as a protein source in animal feed. Changes in rendering practices in the early 1980s may have enhanced the causative agent's ability to survive in meat and bone meal, resulting in the transmission of the disease back to cattle. This increased the spread of the epidemic. However, there is no evidence that BSE spreads through contact between unrelated adult cattle, or from cattle to other species by contact.

As of late March 2001, 177,812 head of cattle on 35,158 farms had been diagnosed with BSE in Great Britain. These animals have been destroyed.

### From Cows to People?

In 1996, Great Britain announced that there was a possible link between BSE in cattle and vCJD in humans. This rare, but always fatal, human disease is characterized by progressive deterioration of brain tissue. The new strain differs from "classical" CJD in that vCJD has an unusually early age of onset of symptoms, an unusual clinical course with psychiatric problems, a prolonged duration of illness, and brain lesions visibly different from those associated with classical CJD.

Classical CJD occurs sporadically, and has no known link to any animal TSE. Investigators found that BSE in cattle and vCJD in humans are related, but vCJD has not been linked to any other TSE.

Scientists are not yet certain how BSE is linked to vCJD. However, many scientists now believe that humans may be infected by eating brain and/or spinal cord bovine products contaminated with some kind of causative agent, such as a "prion" or abnormal protein (Lorains et al., 2001).

Current tests cannot detect the disease in live animals. Microscopic post-mortem examination of brain tissue and tests for prion protein are the primary methods used to confirm a diagnosis of BSE in cattle, or of vCJD in humans.

As of March 30, 2001, vCJD has caused 97 deaths in the U.K. (U.K. Dept. of Health, 2001), two (plus one probable) in France, and one in the Republic of Ireland. No cases of vCJD have been detected in the U.S.

TABLE 1

## United Kingdom Exports of Beef and Veal, and Cattle, 1989-1998[1]

| | Beef and Veal | | Cattle | |
|---|---|---|---|---|
| YEAR | QUANTITY (METRIC TONS) | VALUE (1,000$) | QUANTITY (HEAD) | VALUE (1,000$) |
| 1992 | 74,419 | 288,535 | 429,129 | 110,444 |
| 1993 | 117,771 | 353,597 | 424,589 | 126,217 |
| 1994 | 141,706 | 486,241 | 468,715 | 133,119 |
| 1995 | 148,304 | 531,066 | 392,157 | 103,027 |
| 1996 | 31,893 | 105,084 | 57,067 | 13,276 |
| 1997 | 269 | 832 | 36 | 5 |
| 1998 | 995 | 2,799 | 126 | 36 |
| 1999 | 322 | 1,400 | 17 | 4 |

1 In 1996, the European Union banned imports of UK bovine products and live cattle.

*Source: FAOSTAT Agricultural Data, http://apps.fao.org/page/collections?subset=agriculture, accessed Feb. 26, 2001.*

### Crisis in the U.K.

Immediately after the 1996 announcement, domestic sales of beef products in the U.K. fell by 40 percent. Within a month, household beef consumption fell 26 percent from the previous year's level (Atkinson, 1999).

The U.K. had developed a significant export trade in live cattle and beef during the early 1990s; this was hard hit by the European Union's March 1996 ban of U.K. live cattle and bovine products (Table 1). Other export markets followed the E.U.'s lead, lowering real producer cattle prices in the U.K.

In the first year of the crisis, the total economic loss from BSE to the U.K. was estimated at £740-£980 million (Atkinson, 1999)(US$1.07-$1.4 billion assuming £1=US$1.444). The cumulative gross budgetary cost of BSE to the U.K. between March 1996 and March 31, 2000 stands at roughly £3.5 billion (US$5.05 billion), and was expected to reach £4 billion (US$5.8 billion) by March 31, 2001.

The U.K. government undertook policy changes aimed at eradicating BSE, preventing its transmission to other animal species, and protecting consumers of beef products in the U.K. and worldwide (Atkinson, 1999). Other measures helped cushion the U.K. beef industry from the full economic impacts of the crisis, and restore public confidence. The BSE epidemic peaked in 1992, and the rate of newly reported cases of BSE is declining (Table 3).

The E.U. rescinded its ban on English beef in August 1999, allowing exports to resume (until the outbreak of foot-and-mouth during the winter of 2000-01).

### BSE Outside the U.K.

While the number of cases of BSE in the U.K. is declining, confirmed cases have risen in other European countries (Table 2). Although BSE has been confirmed in native-born cattle in several other countries, and has been identified in cattle exported from Great Britain, over 95 percent of all cases have occurred in the U.K.

No cases of BSE have been confirmed in the U.S., after over a decade of active surveillance. In fact, there have been no cases of BSE in native cattle in North America. One cow in Canada imported from Great Britain had BSE and was destroyed, along with all of its herdmates and other cattle determined to be at risk by Canadian health officials.

### The Impact on Consumers

In addition to the financial impact of medical care, the emotional toll of this crisis is particularly high. Prior to the 1996 announcement that BSE may have been transmitted to people, the public had been repeatedly reassured that it was safe to eat beef, and that BSE was not transmissible to humans.

This impression helped drive a public feeling of betrayal after the announcement (BSE Inquiry, 2000). Since then, concern about BSE and vCJD has increased worldwide. The mass media has emphasized the severity of the human illness by describing it as relentlessly progressive, untreatable, and invariably leading to traumatic decline and death.

Consumer fears rose even further when the media told human stories in which families of victims essentially watched loved ones "waste away." Furthermore, the media emphasized that because science knew little about the incubation period, no one could predict the eventual human toll. Consumer surveys of Europeans suggest that the BSE crisis has left a lasting impact on food safety risk perceptions, as well as on trust in food safety regulators.

### The U.S. Takes Action

Given the huge and continued impact of the BSE crisis on the U.K. livestock industry and the human health impact and associated costs, the U.S. government has taken proactive and preventive measures to ensure that domestic herds remain free of BSE. Measures undertaken by the U.S. Animal and Plant Health Inspection Service (APHIS) include:

- active surveillance for BSE since 1990,
- ongoing educational efforts such as training veterinarians to recognize BSE,
- a TSE Working Group to analyze the BSE risks to the U.S.,
- import prohibitions and/or restrictions on live ruminants and certain ruminant products, and
- an emergency response plan in the event that BSE is introduced into the U.S.

Additionally, a 1997 Food and Drug Administration (FDA) regulation prohibits the use of most mammalian protein in sheep and cattle feed.

Although there have been no confirmed BSE or vCJD cases in the U.S., the country has been affected in

TABLE 2

## Number of Reported Cases of BSE in Great Britain and Worldwide

| | |
|---|---|
| Great Britain | 177,812 |
| Ireland | 587 |
| Portugal | 543 |
| Switzerland | 371 |
| France | 266 |
| Germany | 57 |
| Spain | 39 |
| Belgium | 25 |
| Netherlands | 9 |
| Denmark | 3 |
| Italy | 2 |
| Liechtenstein | 2 |
| Luxembourg | 1 |

*Source: March 23, 2001 data from MAFF (2001).*

*Source: April 6, 2001 data from the Office International des Epizooties (OIE) website. See original table on OIE website for details and caveats about cases by year of confirmation: http://www.oie.int/eng/info/en_esbmonde.htm. Reproduction or translation of the contents of this site permitted for non-commercial purposes.*

several ways. First, the United States imposed trade restrictions to prevent the introduction of BSE into the U.S. Starting in 1989, APHIS prohibited and/or restricted imports of live cattle, other ruminants, and certain ruminant products from countries where BSE is known to exist in native cattle. Products banned from entry include serum, bone meal, meat-and-bone meal, blood meal, offal, fats, glands, gelatin, and collagen (except under special conditions).

In December 1997, APHIS extended the ban to cover all of Europe. Most recently, in December 2000, APHIS prohibited imports of rendered animal protein of certain species due to the possibility of cross contamination with the BSE agent. In addition to the countries already known to have BSE, these new restrictions apply to at least 18 other countries. The trade effects and any associated economic costs of these bans by the U.S. have not been quantified.

In addition, the U.S. has invested funds for BSE surveillance, educational efforts, and prevention and emergency response efforts. FDA estimated that the 1997 action will ultimately cost the U.S. $52.9 million (FDA, 1997).

Furthermore, the epidemic heightened consumer concerns about food safety in the U.S., though perhaps less so than in Europe where most of the crisis' impacts have occurred.

### Making Its Way Back to the Table

In the U.K. at least, there are several signs that consumer confidence in the safety of beef is beginning to return. In May 2000, total beef consumption in Great Britain increased 4 percent, and the number of homes that purchased beef increased 1 percent, compared to one year earlier (MAFF, 2000). Beef's share of total meats consumed recovered in 1997 and was stable in 1998 (Atkinson, 1999). However, it should be noted that the increase in beef consumption may be due to lower real beef prices (Atkinson, 1999), as well as to the increased confidence by some U.K. consumers in the safety of beef.

On October 26, 2000, the U.K. released a 16-volume report of a public inquiry of the government's handling of the BSE crisis. The report acknowledged that much of the scientific analysis remains inconclusive. It also raised important questions about how governments should cope with scientific uncertainty, and to what extent they should share information with the public (Economist, 2000). The report recommends a policy of transparency.

In addition, the government has taken steps to separate responsibility for food safety from agricultural interests (Economist, 2000). The U.K.'s establishment of an independent Food Standards Agency is one such measure.

On December 4, 2000, E.U. agriculture and farm ministers met to expand E.U.-wide preventative measures. In particular, a six-month ban of the feeding of animal protein–with limited exceptions–to any farm animals began January 1, 2001 (Council Decision, Dec. 4, 2000, 2000/766/EC).

To date, the U.S. has not been directly affected by BSE, as there have been no BSE or vCJD confirmed cases in the U.S. However, the U.S. has been indirectly affected. Active efforts to prevent its introduction into this country continue. Recently, the media alleged that some U.S. firms may not have followed FDA feed ban requirements. These accounts have likely increased U.S. consumer concerns about BSE.

### Piling On: Foot-and-Mouth

On the heels of the BSE crisis, the U.K. has been hard hit by an outbreak of foot-and-mouth disease (FMD; also called hoof-and-mouth disease), an animal disease unrelated to BSE. FMD is a highly contagious and economically devastating disease of cattle and swine. It also affects sheep and other cloven-hoofed ruminants. The first FMD case in this outbreak was confirmed in February 2001. Since then there have been over 1,100 confirmed cases in the U.K.; cases have

recently been identified in the Netherlands. The U.K. is struggling to control further spread of FMD by destroying all animals on infected farms and by restricting the movement of other farm animals. Although FMD does not affect food safety or humans, this outbreak has

TABLE 3

**Confirmed Cases of BSE by Year, 1989-2000**

| YEAR | U.K CASES | WORLD | TOTAL |
|---|---|---|---|
| 1989 | 7,228 | 15 | 7,243 |
| 1990 | 14,407 | 17 | 14,424 |
| 1991 | 25,359 | 26 | 25,385 |
| 1992 | 37,280 | 36 | 37,316 |
| 1993 | 35,090 | 49 | 35,139 |
| 1994 | 24,437 | 103 | 24,539 |
| 1995 | 14,562 | 111 | 14,673 |
| 1996 | 8,149 | 159 | 8,308 |
| 1997 | 4,393 | 159 | 4,552 |
| 1998 | 3,235 | 227 | 3,462 |
| 1999 | 2,301 | 347 | 2,648 |
| 2000 | 1,537 | 527 | 2,064 |

*Source: http://www.maff.gov.uk/animalh/bse/index.html, accessed Dec. 15, 2000. Crown copyright. Reproduced by permission of the Ministry of Agriculture, Fisheries, and Food, United Kingdom.*

fueled renewed consumer concerns about the safety of the food supply and is imposing high economic costs to U.K. farm, tourism, and retail sectors.

### Current Research: What's Happening and What Is Needed

The U.S. government has contracted with Harvard University to perform a BSE risk assessment. Other issues requiring research include domestic and international quarantines, compensation and eradication programs, science and policy decisions, consumer acceptance and behavior, and the economic impacts on farm and food sectors such as renderers, slaughter firms, and beef processors.

This crisis challenges U.S. and international policymakers, scientists, and other interested parties to understand this complicated disease and minimize its impact through sound prevention and mitigation strategies.

### For more information


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