

MAD COW DISEASE IN UK

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Transmissible Spongiform Encephalopathy' (TSE) are diseases characterized by spongy degeneration of the brain with severe and fatal neurological signs and symptoms. They happen in both animals and humans.

Bovine Spongiform Encephalopathy (BSE) is one of the several forms of transmissible brain disease affecting a number of animal species. Examples are scrapie in sheep's and 'mad cow diseases' in cattle.

TSE exists in humans as Creutzfeldt - Jakob disease (CJD). This is a prototype human TSE. CJD occurs in a form associated with hereditary and sporadic. A newly recognized form of CJD is the variant Creutzfeldt - Jakob disease (vCJD) which is associated with BSE in cattle.

Bovine Spongiform Encephalopathy (BSE), also known as 'mad cow disease' in the United Kingdom(UK) is a transmissible, neurodegenerative, fatal brain disease of cattle. This disease has an unusually long incubation period. This period is mostly believed to be between four to five years, but it is fatal for cattle within weeks to months of its onset.

Epidemiological studies show that, the source of BSE was cattle feed prepared from bovine tissues, such as brain, retina, dorsal root ganglia, distal ileum, bone marrow of cattle experimentally infected by oral route and spinal cord that was contaminated by the BSE agent. Appearance of the agent causing the disease has ranged spontaneous occurrence in cattle, the carcasses of which the entered the cattle food chain, to entry into the cattle food chain from carcasses of sheep with similar disease, scrapie. Transmission of the BSE agent to humans, leading to vCJD occurs via ingestion of cattle products contaminated with the BSE agent (Llewelyn CA, 2004). The BSE agent is highly stable, resisting freezing, drying and heating at normal temperatures, even those used for pasteurization and sterilization. Lesions are characterized by sponge-like changes visible with an ordinary microscope. According to the prion theory, the BSE agent is a self-replicating protein and mostly described as a virus-like agent. (Will RG et al, 2004)

The BSE/CJD/ vCJD epidemic in UK started around 1986, possibly before that year. When BSE arrived, it was immediately thought of, because there were no other natural TSEs, to be derived from scrapie and for this to have been fed to cattle in the meal that they ate to increase their milk yield. By this, carcasses of livestock including sheep were fed to ruminants and other animals as a protein rich nutritional supplement. During

this process, carcasses from which all consumable parts had been removed were milled, then added and packaged by the animal food industry. At this time, in this year, any cattle showing a strange neurological disease was killed, the brains removed, and the animal destroyed. According to Ministry of Agriculture, Fisheries and Food (MAFF), it is calculated that, approximately more than 100 cattle had developed BSE symptoms before 1987 and many more would have been infected.

In 1988, Southwood, in a statement published stated that there was a minimal risk to humans as all infected cattle will be slaughtered and that BSE like scrapie did not spread to humans and other animals. Humans could continue eating bovine brain. At that time, their answer to BSE was to prevent all bovine material from entering the food that was fed to cattle. So in 1988, feed manufacturers were stopped from producing animal feed with bovine extracts and all cases of BSE were to be reported to MAFF.

In 1989, the Spongiform Encephalopathy Advisory Committee (SEAC) was setup and this committee immediately recommended that specific offal (brain, spleen, thymus, tonsil, gut) should be discarded and all ill cattle should be destroyed by incineration or burial. In this same year, BSE had been transmitted to various zoo animals in the UK through eating the same feed.

By 1990, the numbers of cases were exceeding 300 cases per week. The CJD surveillance was setup. All offal was banned from export to Europe. The number of cases was building up so fast that the various parts of the animal could no longer be incinerated and had to be buried on a local tip. The cases of vCJDs started to increase.

In 1991, the HSE brought out directives on how to handle BSE infected carcasses as they might be a risk to people involved. Cases of BSE started popping up in the rest of Europe possibly because they had imported infected animals from the United Kingdom. A statutory order from MAFF prevented any use of specified offal. Then came the 'mad calf' syndrome; a calf born to a cow with BSE automatically develops the disease, so all those calves were killed and buried.

By 1993, the estimated number of cases of BSE was in excess of 800 cases per week. The first cases of farmers infected with vCJD started to die. Deaths diagnosed from vCJD started to increase. By this time, compensation to farmers in respect to diseases livestock was exceeding £74.4 million. 85% of all cattle screened were BSE positive. The computer system that had been setup was now found to be ineffective because it could not give information on whether a cow that was being slaughtered was from an infected herd or not.

In 1994, it was detected that a large number of cattle with BSE were born after the feed ban. Therefore it had been transferred from their parents. In 1995, it was estimated that 1.8 million infected cattle would be eaten from UK farms by the year 2001. It was also detected that, in the 1992-1993, the cases of BSE was under reported to a percentage of 60%. Then the Stephen Churchill developed. Around 90% of the dairy cattle in the UK turned out being infected with BSE.

By 1995, it had become clear that BSE may well have infected humans. Contrary to Alzheimer and Creutzfeldt that CJD was contacted by people over age 55, younger persons now had the disease and started dying. 4 teenagers had been reported with vCJD. The EU banned all export of cattle and bovine products from the UK. The farmers also demand all cattle over 30 months to be slaughtered. The number of cattle slaughtered was estimated as exceeding 147,000.

In 1997, some cases of vCJD in humans were linked to blood transfusions from donors infected. A public judicial inquiry into BSE was setup.

From 1998 till now, the number of cases in the UK has been decreasing. The number of cases in the UK for 2005 is currently 7 as at 31.01.2005. the number of native cases of BSE as of December 2000 in the United Kingdom is 180,379. (Brown P, 2001)

But the most significant associated factor to the BSE epidemic in UK is the negligence of the appropriate authorities to take the necessary action at the right time. At the beginning, they were not sure about the disease and kept on reassuring the public that everything was under control until the numbers of cases started to increase. Then they placed a ban on all protein feed derived from ruminants in the UK. But this was not strictly enforced until 1989 when there was clear epidemiological evidence that the causative agent was from the feed. Even then, there was not effort to recover the protein feed that was already in the system so that those who had stocked the feed still had them and used them.

Even in 1989 when this feed was banned, there was already epidemiological evidence from the studies of KURU, the so called headhunter disease seen in Papua New Guinea, that it was possible for humans to be infected after eating the brains of their foes. But British Government Officials at that time said to the public that it was not transmissible to humans. Until the first cases of vCJD started to appear in the public and the numbers started to increase.

These cattle and other animals that had eaten these feed also brought out excreta which was virtually washed into the soil and got into the plants, then passed on the eaters. This vCJD had about 10 year's incubation time because the first cases were announced in

1996. In my opinion, the number of cases could have been reduced if there was the appropriate awareness of the risk to man.

From 1986 through 2001, more than 98% of BSE cases worldwide were reported from the UK, where the disease was first described. The proportion of the annual total number of BSE cases worldwide reported outside the UK increased to more than 25% in 2000 and more than 55% in 2003. (BELAY ED, The public health impact of prion diseases. *Annu Rev Public Health 2005*; 26: in press)

The immediate impact of the BSE epidemic was on the economy of UK, especially on the organic meat industry. Since the onset of the BSE epidemic, the EU has banned all cattle and cattle products from the UK. The nation also lost export markets and it is estimated that over £720 million a year was lost by the UK after the EU decision to ban UK beef and cattle. (Commission Decision 96/239/EC, 1996)

Therefore the income accruing from agriculture has drastically reduced. Predicted net losses in regional income are 0.5% of GDP. Therefore, BSE caused a reduced income for the United Kingdom as a whole.

This affected the individual farmers. The beef and cattle sector includes thousands of small and medium-sized businesses which employed an estimated 130,000 people. (DTZ Piedad Consulting, 1998). Statistics from N. Evans et al, 2003 show that the average net income of farmers per farm started to decrease from 1988/89, reached its lowest in 1990/91. It started increasing again until 1993/94 when it drastically fell to its minimum in 1990/00. The above trend shows that there has been a continuous downward trend in the income of the farmer. This is basically because of the BSE syndrome. Initially the government subsidized the incomes of beef & cattle farmers and by 1992, total spending in terms of compensation had reached £74.4 million. All these monies were from the government. (Caskie, 1999). This also included compensation schemes introduced by the government. By this time, farmers were compensated about £900 for each cattle killed in relation to the BSE syndrome. (The BSE compensation schemes in the years prior to the introduction of the Over 30 Months Schemes (1988 to April 1996) paragraphs 2.48ff)

Another immediate impact of BSE was the loss of jobs. Because of the very sharp reduction in income, employers had to lay off workers. This included the dairy industry and especially when the milk of cattle suspected was to have BSE. About 77% of farmers lost their income and 87% lost their jobs in the beef sector.

There was also loads of money pushed into the BSE inquiry by the government. At April 2000, the government estimated that the total net cost of the BSE crises to the exchequer was £3.7 billion. Total expenditure is estimated at £4.2 billion, of which other EU states

had contributed £487 million. (House of Commons Hansard, 2000). These expenditure included costs incurred by the Ministry of Agriculture, Fisheries and Food (MAFF), the department of health(DH), and other governmental bodies in responding to the emergence of BSE.

Also British public started to reduce demand for beef in fear of BSE. Therefore, local shops whose sole business was to sell beef and cattle meat experienced low patronage and therefore put out of business. They had to shut down because they were not breaking even but really loosing (in terms of profit) since no one bought the meat they sold.

Another important immediate impact to the BSE epidemic was the destruction of live-stock. Initially there was the loss of an estimated number of 200,000 diseased cattle. (Brown P, 2001) These cattle suspected to have the BSE disease. Destruction of over 200,000 cattle to the British economy at that time was a great loss.

This was followed by a destruction of nearly 4.5 million asymptomatic cattle of 30 months old and more. This was because there was a legislation that all cattle more than the age of 30 months were not to be passed on to the public.

The fact is that, it was not all the cattle slaughtered that were infected with BSE of. But these numbers were suspected BSE cases. It was found out that majority of the cattle destroyed at that particular time might not have contracted the disease.

Because at that time those numbers of cattle were suspected cases they had to be killed. After killing them, they had to properly disposed off, so they had to dig and bury the killed cattle. Ecologically, the carcasses of the infected animals will rot and with time decay. The plants will absorb it into their system and humans will eat it again from the plants. Since it has been epidemiologically proven that BSE could be caused by prions, the BSE could enter man again.

The BSE syndrome also affected the tallow, gelatin, and pharmaceutical industries. These industries all used the bovine-derived products. These bovine-derived products were gotten from parts of cattle latter found to breed BSE. And since herds of cattle were being destroyed when suspected to have BSE, their raw material/product (which was found in the cattle) became scarce. They also had to make staff redundant and reduce production. This might have caused them to be producing below expected levels thereby being inefficient in terms of cost. Most of these companies had to close down because they did not have raw materials. It became more serious when the EU decide to adopt and ban all cattle and all cattle products suspected to have the BSE disease. Demand decreased and the few still in business had to shut down or look for new technologies for producing their products.

Beef is a staple food for people living in UK and the restaurant, food retailers. Therefore the emergence of BSE reduced demand inducing reduction of returns (profit). A study in 2001 estimated damages caused by BSE on fast food joints and restaurants to about £12 billion.

Shares of meat companies fell sharply when news broke of BSE. The UK pound also took a knock in foreign exchange as fears rocked the financial, grains and livestock markets.

There was also some positive impact of the BSE epidemic. This was good news for companies in the organic meat industry. Sale of organic meat products are projected to surge as the consumers' fear for food safety. By this, customers increase their demand for organic beef, thereby increasing revenue in that sector because it was deemed more safe. Organically raised cattle are not fed animal remnants and there have been no cases of BSE reported on animals that have been raised their entire lives according to the organic production methods. Organic beef was thus seen by consumers to be safer to eat than non-organic.

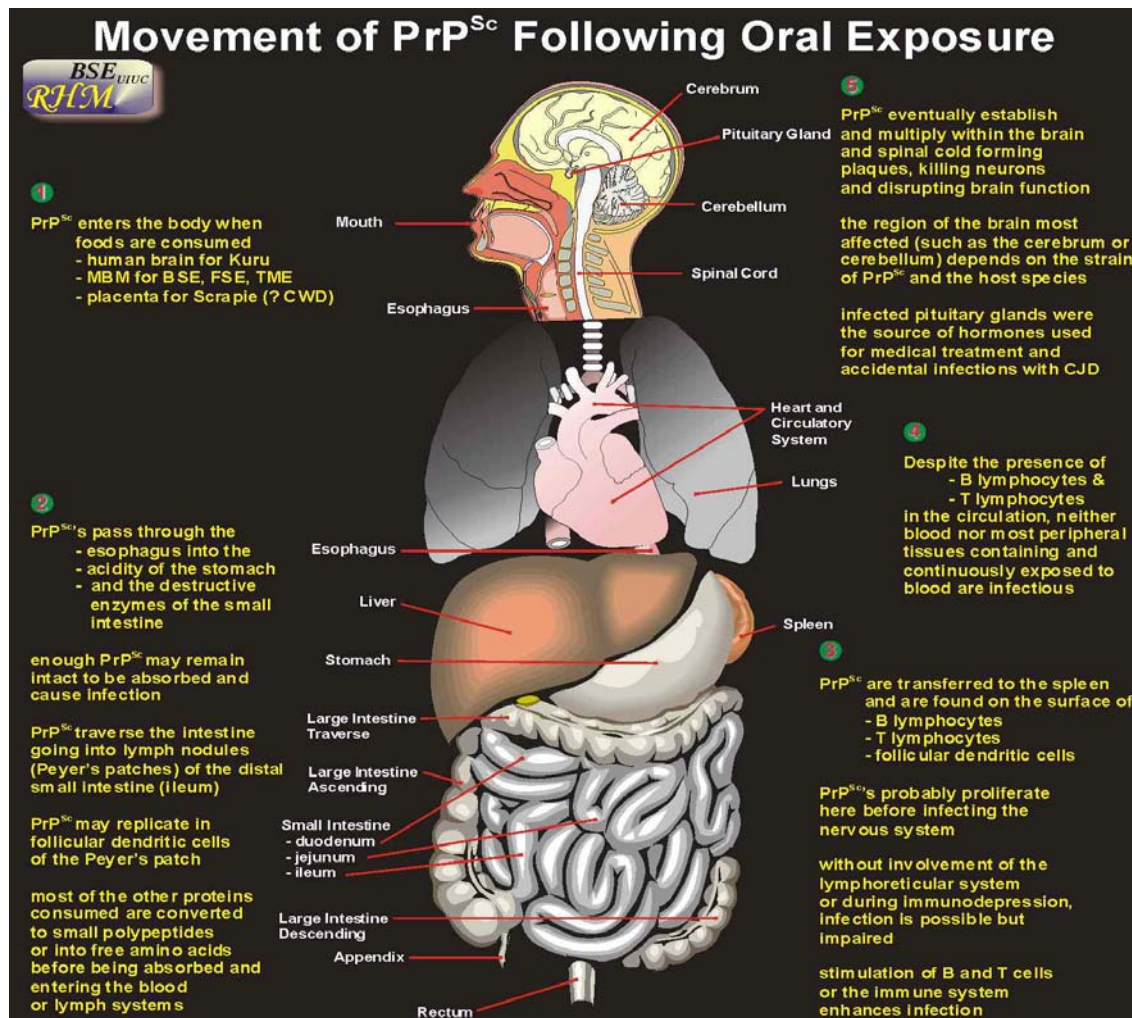


Fig. 1

The organic meat industry has been slow moving compare to other sectors of the organic food industry. Most organic meat is produced on small-scale and there is the absence of distribution infrastructure. Farmers' sell significant volume of organic meat directly to consumers and that which is marketed by retailers is usually priced three times higher than non-organic meat products.

The impact of BSE on the organic meat industry was multi-fold. This included an increase in demand, increase in retailer interest, an improvement in distribution chains, increase in employment in the organic sector, more investment opportunities, increase in research in the production of organic meat on a large scale and an increase in imports and exports of organic meat especially beef. The epidemic of BSE epidemic in the UK which began around 1986 and affected nearly 200,000 cattle was gradually waning to a conclusion but it left the outbreak of human Creutzfeldt-Jakob disease (v-CJD). This disease most probably resulted from the consumption of beef products contaminated by the central nervous system tissue as shown in Fig. 1 above.

In the beginning, a series of measures were taken to eradicate BSE and prevent potentially infected tissues from reaching the human chain. A surveillance unit to monitor CJD was established in the UK in 1990. This was to track down any epidemiological changes of the CJD.

Next was the realization that some exotic zoo ungulates, as well as domestic and captive wild cats were becoming infected. The ungulates and domestic cats had also been fed diets supplemented by meat and bone meals. The wild cats had been fed uncooked tissues including cattle heads and spines. Therefore it became most probable that the disease might cross the barrier species to humans from the consumption of beef or dairy products.

But there was confusion about the origin of BSE and therefore CJD. This is because scientists at that time thought the disease was from scrapie from sheep. And since scrapie did not affect humans, it was thought BSE might not extend to humans and these behaviors were experimented and well known with certainty.

In May 1995, the CJD Surveillance Unit was notified of few cases of CJD with age groups ranging between 16 and 30 years. This contradicted the earlier characteristics of the CJD disease. According to the initial characteristics of the disease, CJD only affected people aged 50 and over.

On further examination, the patients were identified to all have amyloid plaques which was characteristic of CJD. The age group of the patients prompted a search for similar features in patients whose deaths might attribute to other diagnoses. By this time, the

numbers of cases of CJD were fast increasing. More patients of age of 50 years and less were being diagnosed. And all these cases identified confirmed eating beef products. Case numbers continued to increase year by year and it was now convincingly established in laboratory studies that BSE infected cattle caused human cases of CJD. Contamination might have occurred in several ways including cerebral vascular emboli from cranial stunning instruments used to immobilize cattle before killing by exsanguinations; contact of muscle with brain or spinal cord tissue by saws or other tools used during slaughter; inclusion of paraspinal ganglia in the cuts of meat containing vertebral tissue and the presence of residual spinal cord and paraspinal ganglia tissue in the paste of 'mechanically recorded meat' (a carcass compression extract) that could legally be added to cooked meat products.

The first cases of the vCJD disease appeared 10 years after the beginning of the BSE epidemic. Therefore if we assume the minimum incubation/exposure period of the disease to be at least ten years then we will surely expect more cases as the years pass. If the average incubation period is between 10 to 15 years, the earliest patients with vCJD will have been infected in the early 1980's. This meant that BSE existed before the start of the BSE epidemic in 1986 and therefore BSE actually started to increase before the epidemic started.

But unlike the BSE epidemic, the vCJD outbreak showed increase in numbers only during the first 6 years and the numbers after the first six years have been decreasing but although they are decreasing, they are still relatively very high compared with when vCJD did not exist.

This disease started to show all over Europe and this implied more travel restriction to discourage the spread of the disease.

Several governments started to implement policies to minimize the risk of human-to-human transmission through blood donations from healthy persons who were incubating the disease. People who visited the UK with a certain period were not allowed to donate blood in other countries. Even in the UK, people who wanted to donate blood were thoroughly tested for traces of the symptoms of vCJD. (PEDEN AH, Preclinical vCJD after blood transfusion in a PRNP codon 129 heterozygous patient *Lancet* 2004; 264:527-529)

There was a drastic reduction of blood donors across Europe and America. These caused more other deaths because there was a shortage of blood to be given to patients who needed it.

There was also a reduction in tourists to the UK and Europe as a whole. This meant a reduction in foreign exchange and income accruing from tourism, a major part of the GNP of the UK and Europe. The image of the meat industry as well as vCJD has diminished the tourism industry in the UK and Europe as a whole. This deters visitors from coming to the UK for the fear of contracting any BSE related disease or start incubating this disease.

Also, the EU banned animal feed and all dairy products from UK 6 years after the UK had banned it. Within the period the UK banned it and the EU banned it, UK was still exporting animal feed to the EU. This was because the EU said it did not have sufficient evidence and authority to ban these products from the UK. Therefore, after some time, the EU started to record cases of both BSE and vCJD. Although the numbers are relatively small compared to those in the UK, the vCJD effect will remain until the last carrier is found or dead.

From 1995 through 2004, 147 reported human cases of vCJD were reported in the United Kingdom. Most of the patients realized outside the UK were found to have lived or visited the UK during the key exposure period of the UK population to the BSE agent. By the year of onset, the incidence of vCJD in the UK appears to have peaked in 1999 and to have been declining thereafter.

The most important lesson learned from this BSE and vCJD epidemic is the effect of the clash between politics and science. By this, if politicians are put in charge of certain research offices, there is always a conflict of interest.

When the BSE epidemic started, scientists and researchers suspected the disease as well as CJD but the politicians suppressed the suspicions.

Even when there was proof that BSE was in cattle, the politicians did not let the public know until large amounts of cattle was infected. This was partly because it was an election year and the ruling party did not want to enforce a complete ban of cattle feed. This would have put companies out of business, thereby making people redundant. The public would see it as an inefficiency of the government and therefore vote the ruling party out of government.

When politics and science clashes, it is usually the population that suffers. If they had imposed an early ban, the BSE would not have spread so fast therefore reducing the impact on the economy.

As soon as the BSE epidemic started, scientists suspected CJD as a possible addition but politicians wanted evidence as proof before informing the public.

Therefore the first lesson learnt is not to put politicians in charge of certain key research and scientific institutions. These institutions should not be made accountable to the politician but instead be made accountable to the judiciary or the House of Lords. Secondly, even when the ban on cattle feed was imposed; it was not seriously enforced until after 3 years. No effort was made to recall feed already in circulation and farmers did not even understand why they should not feed their cattle on those feed. Since there was no education to the farmers, they were also not willing to co-operate or offer information requested by the government or by the scientific advisory commission. This led to the delay in effectiveness of the feed ban and there were new cases of BSE-infected cattle born after the feed ban (BAB) in 1991. In my opinion, this was a result of the non-control of the implementation by the ministry in charge.

Therefore, the implementation ministry should make sure its solution to the problem is totally exhaustive and very effective from the start of the implementation of the solution.

Technologically, the BSE epidemic led to a high market growth in the organic meat industry. But consumer confidence in non-organic beef will eventually return and will bring stiffer competition in the meat industry. This will enable the forces of demand and supply to determine prices which will lead to a fall in prices of organic meat. Then more research will be conducted into technology to determine a cheaper method of producing organic meat.

In respect of legislations, there have been many since the onset of the BSE epidemic. I just want to mention a few important ones that will be relevant to reducing chances of occurrence of future similar events. In July 1989, D 89/469/EEC was enacted to put restrictions on the dispatch of certain live cattle from the UK. This law was amended on 7 February 1990 with D 90/59/EEC and it was in relation to the dispatch limitation to only calves under 6 months old. There was a legislation D 90/134/EEC on 6 March for compulsory notification of BSE. D 90/200/EEC was on the restrictions on the dispatch of certain bovine tissues and organs from the UK. D 92/290/EEC on 14 May was also to put restriction on the dispatch of bovine embryos from the UK. There was also a complete ban in 1994 of the use of proteins derived from mammalian tissues for feeding ruminants (D 94/381/EC) and D 94/382/EC was a detailed legislation for rendering systems for the processing of ruminant waste into MBM (inactivation of BSE agents). D 94/474/EC placed restrictions on the dispatch from the UK of live cattle and certain ruminant products. Thus the destruction of specified offal's (repeals D 89/469/EEC and D 90/200/EC).

In 1995, D 95/29/EC, D 95/60/EC and D 95/287/EC were amendments to batch rendering systems, derogation to the feed ban and certification for beef dispatch respectively. In 1996, under D 96/239/EC, there was a total ban on live cattle and all cattle products from the UK (UK embargo) and there was also an eradication programme for BSE in the UK. There were also restrictions to trade in MBM under D 97/735/EC. D 98/272/EC was an epidemio-surveillance for all animal TSEs. Conditions for the productions of MBM and tallow were incorporated in D 1999/534/EC and there was a temporary ban on the use of MBM under D 2000/766/EC.

There have been several amendments to these legislations and these have been in subsequent years like 2002, 2003, 2004 and 2005. All the new legislation are amendments to the ones already in existence and these legislation have been very effective to the eradication of BSE and vCJD.

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