Animal & Plant Health Agency

Report on the epidemiological investigation of a BSE case in Scotland

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APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.

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Executive summary

On 9 May 2024, Scotland's Chief Veterinary Officer (CVO) confirmed a case of classical bovine spongiform encephalopathy (BSE) in a 7.5-year-old cow on a beef suckler farm in Ayrshire, Scotland. This was the first case of classical BSE to be confirmed in the United Kingdom (UK) since 2021, and in Scotland since 2018. This report summarises the epidemiological investigations that have been carried out to describe and understand this single case of BSE.

The index case was a Simmental cross cow, born on 18 October 2016 in a holding in Dumfries and Galloway, Scotland. It was purchased and introduced into the incident herd on 27 June 2018, where it resided until its death.

The index case died on farm on 26 April 2024. The farmer did not suspect notifiable disease and the carcass was collected by the fallen stock company on the same day. The carcass was tested for BSE as per the UK's statutory BSE surveillance procedures due to the cow's age and because she was fallen stock.

A preliminary positive result was received on 1 May 2024. A final positive result was confirmed on 9 May 2024 by the Animal and Plant Health Agency (APHA) Weybridge. APHA Weybridge is the UK National Reference Laboratory (NRL) for transmissible spongiform encephalopathies (TSEs). It is also the World Organisation for Animal Health (WOAH) Reference Laboratory for BSE and scrapie.

Tracing investigations identified 2 offspring born in the 24 months prior to the clinical onset of disease and death of the index case (see also appendix 2, point (f)):

- The first one had a date of birth (DOB) of 13 May 2023. It was alive at the time of confirmation and placed under restrictions following BSE confirmation in the index case. It was transported alive to the NRL for TSEs in Weybridge for clinical observation. It was then euthanised and underwent a postmortem examination and BSE testing, with negative results.
- The second one had a DOB of 21 May 2022. It was already dead (slaughtered for human consumption and not eligible for BSE testing) when traced after the BSE case was confirmed.

Tracings investigations also identified 45 cohort animals born and/or reared with the index case during the relevant risk period (12 months either side of the date of birth of this case). Of these, 43 were restricted and humanely culled on farm at their respective locations. The carcasses were sampled for BSE testing and then disposed of as category 1 animal by-products (ABP) at an approved ABP rendering facility. All the samples returned negative results for BSE. The remaining 2 cohort animals were already dead when traced after the BSE case was confirmed. (They were slaughtered for human consumption and not tested for BSE as they were not eligible.)

Epidemiological investigations were undertaken at both the holding of birth and the holding of death of the positive BSE case. Following these investigations, the most likely source of infection remains undetermined. Four potential risk pathways were identified and assessed as very low likelihood events, all with high uncertainty. These 4 potential risk pathways were:

- accidental exposure to contaminated feed (possibly feed delivered before the reinforced feed ban that had remained attached to the side walls of a feed silo decommissioned in 2017) (see also appendix 2, point (b))
- maternal transmission
- environmental source 1: exposure to previous potential presence of the BSE agent on the natal farm via birth products
- environmental source 2: exposure to previous potential presence of the BSE agent on the natal farm from on farm or local cattle burials (when it was still legal to do so before 1 May 2003) via contaminated groundwater or other pathways (see also appendix 2, point (c))

The likelihood of any other potential risk pathways has been assessed as negligible.

Any identified sources of infection have been effectively controlled through the following measures:

- The positive animal died on farm and was not destined to enter the food chain. As fallen stock, the entire carcass was category 1 ABP and was appropriately disposed of.
- Rearing cohorts and offspring cohorts were traced, culled and disposed of. All those culled cohorts and offspring were tested for BSE with negative results.
- Surveillance and testing of at-risk animals and fallen stock (see appendix 2, point D).
- Elimination of animal proteins from cattle feed as primary route of transmission (reinforced feed ban in effect since August 1996, see appendix 2, point B).
- Effective disposal of specified risk material (SRM) as per legislative requirements (see appendix 2, point E).
- Ban on burying fallen stock (dead animals) on farms since 1 May 2003 (see appendix 2, point C).
- The old feed silo was decommissioned in 2017.

The implementation of these control measures ensures that the risk of BSE agents being recycled within the bovine population has remained negligible. There is no evidence or other cause for concern that statutory official BSE or feed controls have been breached at any point in relation to this case or its herd of origin.

The detection of this case is evidence that the UK surveillance system for detecting and containing BSE is robust and effective. There is no threat to food safety, to human health or to animal health as a consequence of this case.

Introduction

Background

On 9 May 2024, Scotland's CVO confirmed a case of classical BSE in a 7.5-year-old cow on a beef suckler farm in Ayrshire, Scotland. This was the first case of classical BSE to be confirmed in the UK since 2021, and in Scotland since 2018.

Aim of this epidemiological investigation and report

An epidemiological investigation was carried out to collect all the relevant epidemiological data and try to ascertain the likely origin of exposure to the BSE agent. Data and documentation collected for the investigation included:

- a standard epidemiological questionnaire
- field visits (including detailed inspection of the premises and of farm records on both the natal and incident farm)
- telephone and email communications.

Other data sources used included:

- British Cattle Movement System (BCMS) and Scottish EID Livestock Traceability Research (ScotEID) data
- APHA databases, including Sam (APHA IT system)
- historical UK BSE data and investigations
- National Feed Audit (NFA) information related to the feed suppliers

Prevention, control and eradication measures for BSE are built on the understanding, based on scientific evidence, that classical BSE is transmitted either:

- via feed contaminated with infectious prion protein (PrPSc) given to a bovine animal during the first year of its life
- transmitted vertically (Ricci and others, 2017)

As the BSE case was moved from the natal farm to the incident farm as a 20-month-old heifer, this document focuses on the likely exposure at the natal farm.

This report presents the findings and outcome of this investigation. It documents all the control measures applied to ensure that:

- any identified source of infection has been controlled
- the risk of BSE agents being recycled within the bovine population has continued to be negligible

Investigation of potential sources of exposure

Timeline

Table 1: Timeline of index case life events.

Date (exact date given where available)	Event
18 October 2016	Birth (normal delivery). Dam (Aberdeen Angus, date of birth was 7 October 2011, third calver).
18 October 2016 to 1 December 2016	The animal was reared in the field with 40 other cows and calves.
December 2016 to April 2017	The above group was moved to a shed for wintering.
April 2017 to December 2017	Animal was moved back to the field.
December 2017 to April 2018	Animal moved back to the shed for wintering.
April 2018 to 27 June 2018	Animal back to the field for summer grazing.
27 June 2018	Animal sold and moved to the incident farm along with other 15 heifers from the same natal farm.
27 June 2018 to December 2018	Animal plus the 15 heifers placed on a field with a bull.
December 2018 to May 2019	Animals moved inside the cow shed for wintering.
29 May 2019	First calving – beef male calf, normal delivery.
16 May 2020	Second calving – beef heifer calf, normal delivery.
25 May 2021	Third calving – beef heifer calf, normal delivery.
21 May 2022	Fourth calving – beef male calf, normal calving.
13 May 2023	Fifth calving – beef female calf, normal calving.
23 April 2024	Farmer first noted clinical signs of abnormal behaviour – (aggressiveness), recumbency and paresis. The farmer kept the animal under observation over the following days but did not suspect notifiable disease and did not contact his private veterinary surgeon (PVS).
26 April 2024	Animal died on farm and was collected by fallen stock company for BSE testing.
1 May 2024	Preliminary positive result received for BSE.
9 May 2024	Final classical BSE positive result received. Scotland's CVO confirmed disease.

Index case

The index case was a 7.5-year-old Simmental cross cow, born on 18 October 2016 in a herd located in Dumfries and Galloway, Scotland (referred to in this report as ‘natal farm’). It was purchased from this farm on 27 June 2018 into a farm in Ayrshire Scotland (referred to in this report as ‘incident farm’). It remained at the incident farm until its death on 26 April 2024. The animal did not reside on any other holding during its lifetime.

Following its death, the entire carcass was collected by a fallen stock company on the same day and taken to an approved TSE sampling site. Due to its BSE risk category (fallen stock over 48 months old), the carcass was sampled and tested for BSE as per the UK’s statutory BSE surveillance procedures (appendix 2). The carcass was then taken to an approved category 1 ABP rendering plant where it was processed as category 1 ABP.

Laboratory results

A preliminary positive result was received on 1 May 2024. On 9 May 2024, a final positive result was confirmed by the UK NRL for TSEs and the WOAH Reference Laboratory for BSE and scrapie (APHA Weybridge).

Prion protein (PrP) genotyping was carried out. The bovine PrP Open Reading Frame genotype is 6:wt/6:Q78. This is common among cattle and no unusual polymorphisms were identified.

An inspection of BCMS and ScotEID confirmed that the index animal had been permanently identified and traceable all through its life, as per legislative requirements. DNA analysis at APHA Weybridge showed a match between the ear tissue collected from the suspect animal and the brain samples that were received and tested BSE positive.

Clinical signs

APHA carried out official veterinary investigations at both the natal and incident farms. The farmer at the incident farm reported that:

- the positive animal was a pregnant dry (not lactating) cow. Her previous calf weaned in February and she was due to calve again in June. She had been losing body condition over the previous 2 weeks
- On 23 April 2024, the animal became recumbent (which the farmer attributed to a possible injury after a fight with another animal) and aggressive. The animal could move the front legs but had no power in its hind quarters. She was eating and drinking as normal. The farmer had not noticed any behavioural changes prior to this incident. The animal was kept under observation over the following days, but the farmer did not suspect notifiable disease and did not contact his PVS.
- On 26 April 2024, the animal was found dead.

Cohorts of the index case

All cattle, including the index case, were reported to have been housed from December 2016 until April 2017. This included a group of approximately 40 cows and calves containing the index case, which were housed together. Throughout the summer, this group of animals along with the index case were also kept in the same field. During the subsequent winter months, they again shared the same shed. These animals all received the same feed, which was also the same feed provided to all other groups of cattle on the farm. Details of the feed and suppliers are provided in a later section of this report.

The investigation identified a total of 45 cohort animals. These had been born and/or reared with the index case during the relevant risk period of 12 months either side of the date of birth of this case (see also appendix 2, point (f)). Of these cohort animals:

- 28 were still alive on the natal holding
- 13 were still alive on the incident holding
- 2 were still alive on two other holdings
- 2 were already dead (slaughtered for human consumption and not eligible for BSE testing) when traced after the BSE case was confirmed

The 43 cohort animals were placed under official movement restrictions. They were culled, sampled and tested for BSE, all with negative results. The list of these cohort animals is at Appendix 4, Table 7.

Offspring of the index case

The index case had calved at the incident farm 5 times. This included 2 born within 24 months of the clinical onset of disease and death of the index case:

- The first one, with a DOB of 13 May 2023, was alive at the time of confirmation in the index case and was placed under restrictions. It was transported alive to the NRL for TSEs in Weybridge for clinical observation. It was then euthanised and underwent a postmortem examination and BSE testing, with negative results.
- The second one, with a DOB of 21 May 20222, was already dead (slaughtered for human consumption and not eligible for BSE testing) when traced after the BSE case was confirmed.

The other 3 offspring (born in 2019, 2020 and 2021) were also traced. Two had been slaughtered prior to confirmation of disease in the index case and one was still alive. No further action is required as they are not ‘relevant offspring’, as per retained European Union (EU) legislation.

Dam of the index case

The Dam (mother) of the index animal was born in 2011 in the natal holding. She was 7 years old at the time of her death. She was reported by the farmer to have good maternal instincts, with no calving problems. She was always in a good state of health and good body condition and had never been subjected to any surgical procedures or other treatments. She was sold at market and consigned directly to an abattoir. She was slaughtered as a healthy cow in an abattoir in April 2018, so she was not eligible for, nor subject to, active BSE surveillance testing.

She had 3 other calves in her lifetime, all slaughtered via abattoir and not eligible for BSE testing.

Veterinary treatments

Medicine records were available for the period during which the index case was present at the natal farm. No treatments or interventions were recorded against this animal.

As confirmed by the farmer and private veterinary surgeon at the incident farm, the index case had not been subject to any veterinary surgical interventions (for example, caesarean section) during her life. She was never subjected to artificial insemination and no embryo transfer or blood or serum products were administered. Medicine records at the incident farm indicated she received routine de-worming and vaccinations (against Blackleg, Leptospira and Bovine Viral Diarrhoea) when required.

Investigation at the natal herd

Location and area description

The natal farm is located within the Dumfries and Galloway region in south-west Scotland.

The local area is made up of small villages and livestock farms, with small patches of woodland interspersed.

There are 3 dairy farms and one beef farm contiguous to the natal farm. There are 2 indoor poultry farms between 5 and 9 miles away from the natal farm and one distillery approximately 3 miles away. There are no ABP plants, abattoirs or feed mills nearby, nor is there evidence of former ABP plants or feed mills.

Description of the cattle herd

The cattle herd is a beef suckler unit, comprising 142 breeding cows, 140 calves and 4 bulls at the time that this case was disclosed. It is a closed herd that produces most of its own replacement breeding animals and rarely buys animals in. This farming practice has not changed since 1992 (purchase of farm) in terms of size, breeds and management. Breeding is only carried out using natural service by the bull. There is no artificial insemination carried out and no embryo transfer has been used on this farm.

Replacement breeding animals are produced on farm. The heifers that are not kept for breeding are fattened and sent directly to slaughter when they are 2 years of age. Some bullocks are sold via market or to other farms at 18 months of age. Other bullocks get fattened on farm and go directly to slaughter between April and September.

Other species

There are also approximately 400 sheep on farm, divided in 2 lots of 200 mule ewes and 200 blackface ewes. Female lambs are kept for breeding and male lambs are fattened and sold at the market.

Sheep are kept outside in the fields all year round. The sheep co-graze with the cattle at certain times of the year (not during winter as cattle are housed from December to April approximately). Lambing takes place outside in the same fields. The sheep are fed ewe nuts pellets on the ground before lambing in March and April while on the land, but never when cattle are present (Table 2). As the feed ban applies to sheep feed as well as to cattle feed, cross-contamination would not be a risk even if it had occurred.

Table 2: Feed provided to sheep at the natal farm.

Start date	End date	Feed type	Supplier	Bulk in silo	Bag	Storage
15 March 2015	30 April 2018	Ewe nuts	Supplier 1	Not applicable	Yes	In bags left in the shed

No cases of scrapie have been confirmed in this flock. Only one sheep sample appears to have been eligible for TSE testing (in 2003, with negative results) in this sheep flock under our official active surveillance program, according to the TSE surveillance records.

There has been a farm dog for over 11 years at the natal farm. It is kept in the dwelling house and its food is stored there too (not accessible to cattle). The dog is fed commercial feed purchased from supermarkets or agricultural feed merchants. The dog has been fed the same brand from birth (18 October 2015) until the present time.

Farm history

The cattle herd transitioned from a dairy herd to a beef suckler unit in 1992 when the natal farm was purchased by the current owner, who established a new beef herd. Before that it was a dairy farm. The cows from the dairy herd were sold on farm in spring of 1992 to other farmers. There are no records either on farm or on the Cattle Tracing System (CTS) of cattle sold in 1992, as farm registers are required to be kept for 10 years after the last entry (that is, until 2002 for the dairy farmer who sold the farm in 1992). Data from CTS starts from 1 July 1996.

Due to a foot and mouth disease (FMD) outbreak in the area in 2001, the beef suckler herd underwent a depopulation of all the animals and a subsequent cleansing and disinfection. To note, the disinfectant treatments used for FMD are not effective in TSE disinfection.

All the animals were killed in the summer of 2001 and the carcasses removed from the premises (not burned or buried on farm). A new beef suckler herd was reintroduced in the autumn of 2001.

The current farm records appeared satisfactory, covering feed, cattle movements and medicine use.

The farmer's recollections and accounts of historical farming practices align with the typical systems in the area. However, given the time elapsed since the birth of the index case, some recall bias cannot be ruled out.

BSE history

According to the APHA TSE surveillance system, there were 3 previous confirmed cases of BSE on the natal farm. These were registered to the previous dairy holding and disclosed between 1991 and 1992 before the dairy herd was sold.

Additionally, several BSE cases were disclosed in other holdings in the area around the natal farm between 1990 and 2006.

Since 2002, 245 samples from cattle from the natal farm were TSE tested, all with negative results. These included:

- 173 cattle TSE tested at the natal farm, including 69 fallen stock
- 72 cattle with herd mark of the natal farm TSE tested at other locations

Description of buildings and grazing land

The natal farm includes 26 fields, some of which are separated from the rest by a minor road. The farmer reported that the index animal was born in field 25 and always grazed in that field. The farmer reported that the layout of the farm has not changed since 1992, apart from the replacement of a silo in 2017.

There was an old feed silo (referred as ‘silo 1’ in this report) present at the farm since before the farm was purchased in 1992 from the previous dairy herd owner. This was reportedly a wooden silo that fell due to strong winds and was then burned down on farm in July 2017. The farmer has also stated that they did not ‘sweep out’ any leftovers of old feed from it and did not feed any leftovers to the BSE case and cohort group.

A second silo (referred as ‘silo 2’ in this report) was purchased in September 2017 to replace silo 1. The farmer has confirmed this was a brand-new silo. This change of silos occurred within the first 12 months of life of the BSE-positive animal. The animal would have consumed the beef nuts from both silos from 4 months old until being sold to the incident farm.

Silos are 'swept out' before the next load of feed. No disinfection takes place between loads and there is no carryover of old feed.

There is an old barley store reportedly used only for the dairy herd up to 1992 by the previous owners.

All the buildings were cleaned and disinfected after 2001 due to a FMD outbreak. But as per document retention protocols, these documents are not available. There is high uncertainty that cleansing and disinfection would have been applied to the interior of silo 1. The disinfectant treatments used for FMD would also have not been effective in TSE disinfection.

Feed and water

Animals are fed and watered in troughs located in the sheds and in the fields.

The water supply has been the same since 1992 (purchase of farm) from a natural spring located on the farm boundary at about 3 miles away. The water is piped (via underground plastic pipes) from the source and pumped into sheds and water troughs. No information is available on the routes of water springs.

Table 3: All feed provided to the index case at the natal farm.

Start date and index case age	End date and index case age	Feed type	Supplier	Bulk in silo	Bag	Purchase frequency	Storage
3 November 2016 – 3 weeks old	15 April 2017 – 6 months old	Calf mixture	Supplier 1	Not applicable	Yes	1 tonne every month	In bags left in the pallets in the shed
5 February 2017 – 4 months old	10 October 2017 – 8 to 12 months old	Beef nuts	Supplier 2	Yes	Not applicable	1 bin every week	In silo 1 (up to July 2017) and then in silo 2 (from September 2017)

Start date and index case age	End date and index case age	Feed type	Supplier	Bulk in silo	Bag	Purchase frequency	Storage
12 January 2017 – 3 months old	10 October 2017 – 12 months old if sold on or for life if replacement	Silage and hay	Home-grown	Bales	Not applicable	Not applicable	In shed
15 April 2017 – 6 months old onwards	Until sold to incident farm on 27 June 2018	Magnesium	Supplier 3	Box	Not applicable	3-4 times a year	In shed

National feed audit data for the last 10 years (since 1 April 2014 until 31 March 2024) indicates that APHA carried out 24 sampling inspections at supplier 1's feed mill and 29 sampling inspections at supplier 2's feed mill. These all had negative results.

Cattle burials on farm

The farmer informed our investigation by stating that no cattle carcasses were buried on farm at the depopulation during the FMD event in 2001. (The carcasses were taken away to a common burning or burial site in Dumfries more than 50 miles away.)

However, the farmer also informed that carcass burial occurred on farm when it was still legal to do so (before 1 May 2003) in field 26. This is adjacent to the field 25, where the index case was born and reared.

Calving management

The farmer reported that calving at the natal farm is done in two blocks – autumn and spring. Both are done outdoors in the fields. The index case was born in October 2016, outdoors in one of the natal farm fields (field 25). The placenta was not removed from the field as it is not a common practice at the natal farm.

There was no artificial colostrum given to the index case or other calves in the herd as there were no problems associated with the newborns. All cattle were later housed in a shed in December 2016 until April 2017.

Some feeding with cattle pellets or beef nuts occurred outdoors. The positive case was kept in the field from birth until December 2016, and then again from April 2017 until December 2017 approximately. So, if the soil had become contaminated in previous years with blood, amniotic fluids or placenta, the positive case may have been exposed to them within the first year of its life.

Other potential sources of environmental contamination

The farmer informed that:

- slurry or manure is all spread on the premises' arable land (not on grazing land)
- commercial inorganic fertiliser is purchased from an agricultural merchant and spread on the grazing fields 2 weeks before the animals are out to grazing. These current practices have been followed since the purchase of the farm in 1992 and nothing has changed
- processed animal protein fertiliser has never been used
- no organic fertiliser or waste has been brought onto the premises since 1992

Born after the reinforced ban (BARB) cases in Great Britain (GB) since 28 May 2008

The UK's official 'starting date' from which the risk of BSE agents being recycled within the bovine population has been negligible is 28 May 2008. There have been 4 cases of classical BSE in GB disclosed in animals born after 28 May 2008. The epidemiological investigation did not identify any geographical clustering or epidemiological links between this BSE case and the 3 previous BARB cases (disclosed in 2015 in Wales, in 2021 in England and in 2018 in Scotland).

Assessment of potential sources of exposure

European Food Safety Authority (EFSA) opinion on BSE cases born after the total feed ban has been used as a reference. This was to ensure a systematic investigation and assessment of potential sources of exposure in this case (as represented in Figure 1 below).

Risk pathways of potential infection sources are:

A. Feed – milk replacers
B. Feed – concentrates
C. Feed – concentrates or feed for other species
D. Maternal transmission
E. Environmental contamination from previous BSE cases via birth products
F. Environmental contamination from previous BSE cases via water (or other pathways) from buried carcasses
G. Environmental contamination from application of manure, sewage or organic fertiliser
H. Environmental contamination from previous TSE cases via birth products of other species (sheep)
I. Iatrogenic (vet treatments or investigations)
J. Genetic
K. Spontaneous origin

Figure 1: Risk pathway diagram showing potential infection sources.

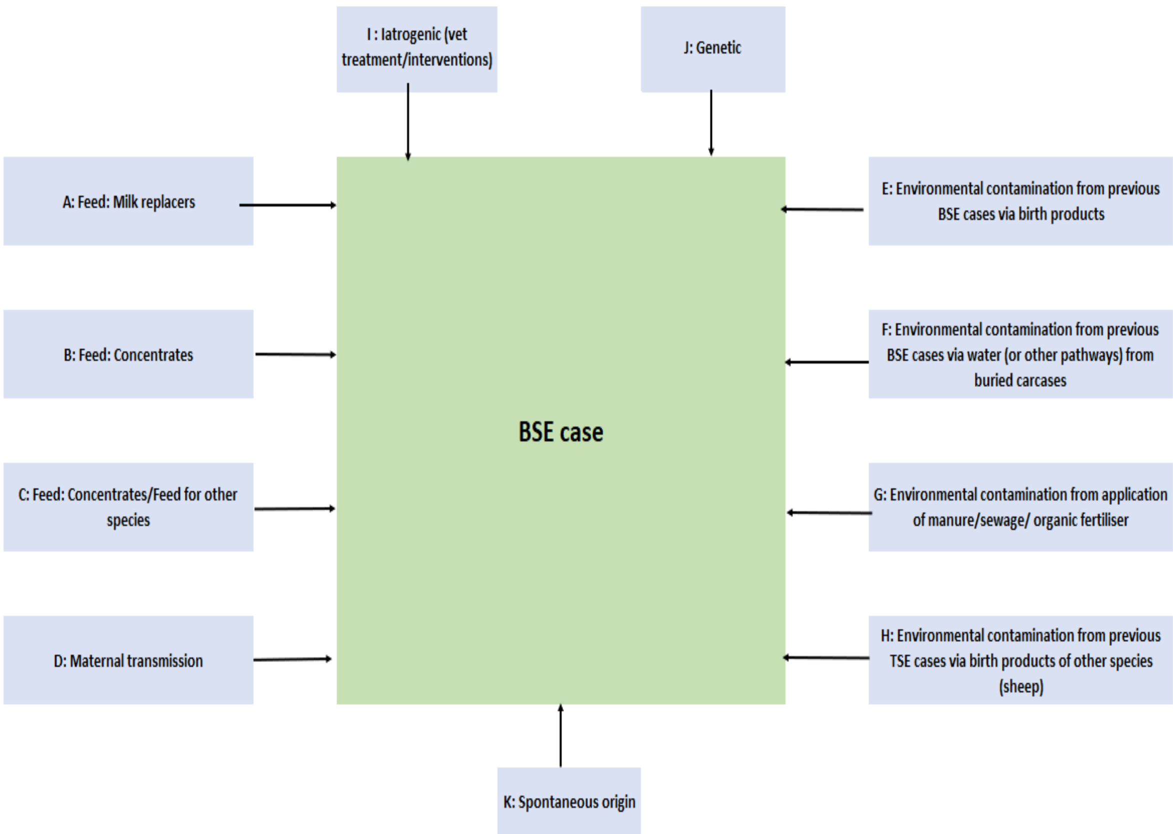


Table 4 below presents a summary of the likelihood assessment, followed by a discussion of those potential source or risk pathways, considering the presence or absence of the relevant risk factors and quantitative data as in Appendix 1.

Table 4: Likelihood assessment of potential source or risk pathways.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
A – Feeding 1: from milk replacers	No milk replacers were used for the index case (or any other animal) as reported by the farmer at the natal farm.	Not applicable	Low uncertainty as this was a suckler cow, typically milk replacers are not used on this type of farm, so this is consistent with the information from the farmer.	Negligible likelihood, low uncertainty.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
B – Feeding 2: concentrates at natal farm	Three BSE cases were disclosed between 1991 and 1992 in the dairy herd belonging to the previous owner. Potential accidental cross-contamination in silo 1 with BSE agent in concentrate feed used for index case during first 12 months of life: older feed remnants (silo in use before the total feed ban was implemented in 1996) of potentially contaminated feed might have remained in silo 1 and could have been accidentally released in the concentrate feed ingested by the index case.	During first 6 months of life, commercial feed purchased and stored in bags was used for the index case. Likely production dates 2015 to 2016. Between 4 to 12 months of life, commercial feed purchased in bulk and stored in silo (1 or 2) was used for the index case. Likely production dates 2015 to 2016. Total feed ban in place since August 1996. NFA inspections: For the last 10 years (from 1 April 2014 until 31 March 2024), APHA carried out 24 sampling inspections at supplier 1's feed mill and 29 sampling inspections at supplier 2's feed mill, all with negative results. Silo 1 has been used regularly since the farm was purchased by the current owner in 1992, with no additional BSE cases disclosed. The farmer stated that they did not 'sweep out' any leftovers of old feed from silo 1 when this fell and did not feed any leftovers to the BSE case and cohort group. Since 2002, 245 cattle samples originating from this farm tested for TSE, all with negative results.	Natal farm buildings cleaned and disinfected after 2001 due to a FMD outbreak. But there are no records of these operations and there is high uncertainty that this applied to the interior of silo 1. Additionally, the disinfectants used for FMD would not be effective in TSE disinfection.	Very low likelihood, high uncertainty.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
C – Feeding 3: feed for other species at the natal farm (sheep and dog feed)	Potential contamination with BSE agent of the concentrate feed used for sheep, provided at grazing, which could have been accessed by the index case during first 12 months of life. Potential contamination with BSE agent of the pet (dog) food.	Commercial feed purchased and stored in bags used for sheep at certain periods (lambing) provided outdoors. Likely production dates 2015 to 2016. Although co-grazing is reported to occur, this does not take place when sheep feed is provided. Total feed ban (which applies also to sheep feed) in place since August 1996. Dog food kept away from cattle. Dog food is from a single source. It is a well-known commercial brand, with only category 3 ABP used for its production. Dog in farm only since 2015, at a time when the likelihood of any cross-contamination during production of the pet food with historic potentially infective material can be considered negligible.	Potential access of index case to any remnant sheep feed (however this feed would have posed a negligible risk, based on the feed ban).	Negligible likelihood, low uncertainty.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
D – Maternal transmission	Dam born in 2011. (Although not epidemiologically linked to this confirmed BSE case, there have been 2 animals born from 2011 onwards subsequently confirmed as BSE positive in GB in addition to index case). The BSE case was born when the Dam was 5 years old.	Dam displayed no clinical signs nor suspicion of BSE during lifetime and was slaughtered as a healthy cow at 7 years old. Dam was born in 2011, well after 1996 reinforced feed ban control. (There have been only 2 animals born from 2011 onwards subsequently confirmed as BSE positive in GB in addition to index case.) Dam had 3 other offspring (in addition to index case). All 3 were slaughtered as healthy animals at 21, 46 and 76 months old respectively.	High uncertainty on the potential role of this pathway in the transmission of BSE. BSE signs could have been displayed in later stages in life, should the Dam had not been slaughtered. Dam (and its 3 other offspring) not tested for BSE when slaughtered as not eligible for testing.	Very low likelihood, high uncertainty.
E – Environmental source 1: From previous presence of BSE on natal farm via birth products	Three BSE cases were disclosed between 1991and 1992 in the dairy herd belonging to the previous owner. Cattle are born in fields outdoors and birth products are not removed. BSE agent potentially viable in the environment over long periods of time.	Since 2002, 245 cattle samples originating from this farm tested for TSE, all with negative results.	High uncertainty on the potential role of this pathway in the transmission of BSE.	Very low likelihood, high uncertainty.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
F – Environmental source 2: Via contaminated groundwater (or other pathways) from disposal of carcases on natal farm	Three BSE cases were disclosed between 1991 and 1992 in the dairy herd belonging to the previous owner. Additionally, several BSE cases were disclosed in other holdings in the area around the natal farm between 1990 and 2006. Carcass burial (as reported by farmer) on farm prior to 1 May 2003 at the natal farm, reportedly in a contiguous grazing field to where the index case was born and reared. Water supply is from a natural spring located in the farm boundary.	No cattle carcasses were buried on farm during FMD depopulation in 2001. Ban on on-farm burial of fallen stock since May 2003. Since 2002, 245 cattle samples originating from this farm tested for TSE, all with negative results.	High: information provided by farmer. No requirement to maintain records, information based on farmer's recollections for over 30 years. Additional uncertainty on any burials in the previous dairy herd before this beef farmer took over in 1992. High uncertainty on the routes of water springs with regards to potential buried carcasses. High uncertainty on the potential role of this pathway in the transmission of BSE.	Very low likelihood, high uncertainty.
G – Environmental source 3: Application of manure, sewage or organic fertilisers	Potential contamination with BSE agent of the fertiliser used on grazing fields.	Commercial fertiliser purchased and stored in bags. Likely production dates between 2015 and 2016. No use of processed animal protein fertilisers as reported by the farmer.	High: information provided by farmer. No requirement to maintain records, information based on farmers recollections for over 30 years.	Negligible likelihood, high uncertainty.
H – Environmental source 4: contamination from previous TSE cases via birth products of other species (sheep)	Sheep co-graze with cattle at natal farm.	No history of scrapie in the flock. No proven natural disease transmissibility between species.	Transmission from sheep postulated as one of the potential hypotheses for the beginning of the BSE epidemic. Any subsequent research or evidence of TSE interspecies transmission.	Negligible likelihood, low uncertainty.

Pathway	Risk factors	Mitigating factors	Uncertainties	Likelihood and uncertainty
I – Iatrogenic transmission	No treatment or interventions to the index case reported at the natal farm.	Not applicable.	Low	Negligible likelihood, low uncertainty.
J – Genetic	Not present: prion protein (PrP) genotyping was carried out and the bovine PrP Open Reading Frame genotype was 6:wt/6:Q78. (This is common among cattle and no unusual polymorphisms were identified.)	Not applicable.	Low	Negligible likelihood, low uncertainty.
K – Spontaneous origin	Not applicable (not all other pathways have been excluded).	Not applicable.	Medium: how the conversion of the cellular prion protein to the abnormal prion protein is triggered is still unknown. Uncertainty on whether classical BSE could occur spontaneously.	Negligible likelihood, medium uncertainty.

Discussion of potential sources of exposure

It is recognised that even so many years after implementation of the total feed ban, detection of sporadic, born after the reinforced ban (BARB) cases is not an entirely unprecedented event. This continues to represent a significant epidemiological challenge in terms of investigation and being able to identify a definitive source of infection for each case. This is due to the:

- significant time delay between exposure to the agent and the subsequent development of clinical signs or post-mortem laboratory detection
- potential associated recall bias or loss of records consequent to elapsed time (Ricci and others, 2017; O'Conner and others, 2018)

EFSA scientific opinion adopted on 7 June 2017 on BSE cases born after the total feed ban indicates that the source of infection cannot be ascertained at the individual level for any BSE case. This highlights the considerable uncertainty associated with the data collected through the field investigation of these cases, due to:

- a time span of several years between the potential exposure of the animal and the confirmation of disease
- recall difficulty
- the general paucity of documented objective evidence available in the farms at the time of the investigation

However, EFSA concludes that when compared with other biologically plausible sources of infection (maternal, environmental, genetic, iatrogenic), feed-borne exposure is the most likely. However, EFSA adds that it is not possible to definitively attribute feed as the cause of any of the BARB cases examined.

A statistical model developed by the APHA in 2017 had previously shown the possibility of further detection of BSE cases in the UK (Arnold and others, 2017). The detection of this new case in 2024 is consistent with the latest update of this model in 2022. The updated model had indicated a 7% probability of detection of further cases, with a very low possibility of further occasional cases up until 2029.

The following potential pathways are discussed below.

A – Feeding pathway 1: Potential exposure to contaminated milk replacer

No milk replacers were used for the index case (or any other animal) as reported by the farmer at the natal farm. This is consistent with the type of farm (suckler herd) in which typically milk replacers are not used.

Pathway assessment

Negligible likelihood, low uncertainty.

B – Feeding pathway 2: Potential exposure to contaminated feed concentrates at natal farm

The index case was fed concentrate feed during first 12 months of life, including:

- during first 6 months of life, commercial feed purchased and stored in bags, likely production dates 2015 to 2016
- between 4 to 12 months of life, commercial feed purchased in bulk and stored in one of the two silos (1 or 2), likely production dates 2015 to 2016

The total feed ban has been in place since August 1996 in the UK.

National feed audit data for the last 10 years (since 1 April 2014 until 31 March 2024) indicates that APHA carried out 24 sampling inspections at supplier 1's feed mill and 29 sampling inspections at supplier 2's feed mill, all with negative results. There are no sampling inspections recorded at the natal farm for the last 10 years.

Three BSE cases were disclosed between 1991 and 1992 in the dairy herd belonging to the previous owner. However, since 2002, 245 cattle samples originating from the natal farm were tested for TSE, all with negative results.

Silo 1 was already on the natal farm when the current farmer purchased the farm in 1992 (previously a dairy herd and since 1992 a beef suckler herd). Although all the farm buildings were cleansed and disinfected after 2001 due to a FMD outbreak, currently there are no records of these operations. There is high uncertainty that this applied to the interior of silo 1. Silo 1 has been used regularly, until it was decommissioned in July 2017.

Therefore, the likelihood that any contaminated feed would have been bought in and stored in silo 1 after the suckler herd was formed following FMD depopulation in 2001 or later in silo 2 (purchased on 19 September 2017) is considered negligible with low uncertainty.

However, the likelihood that older feed (before the total feed ban in 1996) remnants of potentially contaminated feed might have remained in silo 1 and that could have accidentally been released in 2017 is assessed as very low with high uncertainty. This is merely because this case of BSE has been disclosed and there is temporal coincidence with the most likely source window (first 12 months of life of the BSE case). This pathway (ingestion of contaminated feed) is also accepted as the main transmission route for classical BSE, with limited scientific support for other pathways.

Pathway assessment

Very low likelihood, high uncertainty.

C – Feeding pathway 3: Potential exposure to contaminated feed for other species at the natal farm

Concentrate feed is and was used in the natal farm for sheep, provided at grazing, during certain production periods (lambing). Although co-grazing is reported to occur, this does not take place when sheep feed is provided. There is some uncertainty on potential access to sheep feed remnants by the index case during first 12 months of life. However, the sheep feed is commercial feed purchased and stored in bags used for sheep. It was provided outdoors with likely production dates 2015 to 2016, with the total feed ban in place since August 1996. So, any cross-contamination during production of the sheep feed with historic potentially infective material can be considered negligible.

Also, pet (dog) food is provided at the natal farm. However, dog food is kept away from cattle and is from a single source. It is a well-known commercial brand, with only category 3 ABP used for its production. The dog has been at this farm only since 2015, at a time when the likelihood of any cross-contamination during production of the pet food with historic potentially infective material can be considered negligible.

Pathway assessment

Negligible likelihood, low uncertainty.

D – Potential maternal transmission

The Dam of the index case was born in 2011, well after the 1996 reinforced feed ban. Since then, only 2 positive animals born from 2011 onwards have been confirmed as positive to classical BSE in GB in addition to the index case. The Dam displayed no clinical signs nor suspicion of BSE during her lifetime. She was slaughtered as a healthy cow at 7 years old on 31 October 2018 (therefore, the Dam was still alive 2 years after the birth of the case).

The Dam had 3 other offspring (in addition to the index case). All three were slaughtered as healthy animals at 21, 46 and 76 months old respectively.

High uncertainty on the potential role of this pathway in BSE transmission. Additionally, BSE signs could have been displayed in later stages in life (should the Dam or its offspring have not been slaughtered). The Dam and its other offspring were not BSE tested as they were not eligible for testing.

Pathway assessment

Very low likelihood, high uncertainty.

E – Environmental source 1: Potential exposure to previous potential presence of BSE on natal farm via birth products

Cattle (including the index case) are born in fields outdoors on the natal farm, and birth products are not removed. The BSE agent can be potentially viable in the environment over long periods of time.

Three BSE cases were disclosed between 1991 and 1992 in the dairy herd belonging to the previous owner. However, since 2002, 245 cattle samples originating from this farm were tested for TSE, all with negative results.

High uncertainty on the potential role of this pathway in BSE transmission.

Pathway assessment

Very low likelihood, high uncertainty.

F – Environmental source 2: Potential exposure to previous potential presence of BSE on natal farm from on farm or local cattle burials via contaminated groundwater or other pathways

Three BSE cases were disclosed between 1991 and 1992 in the dairy herd belonging to the previous owner. BSE cases were also disclosed in other holdings in the area within a 10km radius of the natal farm.

Carcass burials were reported by the farmer to have taken place on the natal farm prior to 1 May 2003 (date when cattle burials were banned – see also appendix 2, point (c)). These burials were reportedly in a contiguous grazing field to where the index case was born and reared. There is no additional information on numbers of carcasses except that cattle carcasses were not buried on farm during FMD depopulation in 2001. There was no requirement to maintain records, so this information is based on the farmer's recollections going back for over 30 years.

Supply of drinking water for the cattle is from a natural spring located in the farm boundary.

High uncertainty on the potential role of this pathway in BSE transmission. High uncertainty also reflects both potential recall bias and lack of knowledge on the routes of water springs with regards to potential buried carcasses.

Pathway assessment

Very low likelihood, high uncertainty.

G – Environmental source 3: Potential exposure to previous potential presence of BSE on natal farm from application of contaminated manure, sewage or organic fertilisers to grazing fields

Inorganic commercial fertiliser is used in grazing fields. It is purchased from an agricultural merchant and stored in bags. Processed animal protein fertilisers have never been used as reported by the farmer. Manure or sewage is not applied to grazing fields.

There was no requirement to maintain records, so this information is based on the farmer's recollections for over 30 years. High uncertainty reflects potential recall bias and accuracy of information.

Pathway assessment

Negligible likelihood, high uncertainty.

H – Environmental source 4: Potential exposure to previous potential presence of TSE on natal farm via birth products of other species (sheep)

Sheep co-graze with cattle at natal farm. There is no history of scrapie in the flock.

Transmission from sheep was postulated as one of the potential hypotheses for the beginning of the BSE epidemic. But there is no proven natural disease transmissibility of TSE between species.

Pathway assessment

Negligible likelihood, low uncertainty.

I – Iatrogenic transmission

No treatment or interventions were carried out on index case at the natal farm.

Pathway assessment

Negligible likelihood, low uncertainty.

J – Genetic origin

Prion protein (PrP) genotyping was carried out and the bovine PrP Open Reading Frame genotype is 6:wt/6:Q78. This is common among cattle and no unusual polymorphisms were identified. There is no indication that this case could be of genetic origin based on the current understanding of genomics and epidemiology of sporadic cases.

Pathway assessment

Negligible likelihood, low uncertainty.

K – Spontaneous origin

According to EFSA opinion, ‘the classification of a case as spontaneous is circumstantial and may change over time subject to additional information. It does not infer that there is no external cause; just that it could not be ascertained. A case of disease is classified as spontaneous by a process of elimination, excluding all other definable possibilities.’ (Ricci and others, 2017.)

As not all other pathways have been excluded, the likelihood of spontaneous origin is assessed as negligible. Medium uncertainty reflects that the highest likelihood of any other pathways has been assessed as ‘very low, with high uncertainty’.

Pathway assessment

Negligible likelihood, medium uncertainty.

Conclusions on potential sources of exposure

The potential pathways assessed have been ranked below according to likelihood and uncertainty.

1 – Very low likelihood, high uncertainty

- B – Feeding pathway 2: Accidental exposure to contaminated feed concentrates at natal farm. (Old feed remnants of potentially contaminated feed from before the total feed ban in 1996, which might have remained in silo 1 and could have accidentally been released in 2017).
- D – Maternal transmission.
- E – Environmental source 1: Exposure to previous potential presence of BSE on natal farm via birth products.
- F – Environmental source 2: Exposure to previous potential presence of BSE on natal farm from on farm or local cattle burials via contaminated groundwater or other pathways.

2 – Negligible likelihood, high uncertainty

G – Environmental source 3: Exposure to previous potential presence of BSE on natal farm from application of contaminated manure, sewage or organic fertilisers to grazing fields.

3 – Negligible likelihood, medium uncertainty

K – Spontaneous case.

4 – Negligible likelihood, low uncertainty

- A – Feeding pathway 1: Exposure to contaminated milk replacers.
- C – Feeding pathway 3: Exposure to contaminated feed for other species at the natal farm.
- H – Environmental source 4: Exposure to previous potential presence of TSE on natal farm via birth products of other species (sheep).
- I – Iatrogenic transmission.
- J – Genetic origin.

The main sources of uncertainty identified include:

- the origin of the first case of BSE

- the quality and accuracy of data collected during the investigation, which relies importantly on recollections by the farmer at the natal farm over a period of more than 30 years
- the role of other potential transmission sources (maternal, environmental) in the BSE epidemic
- the persistence of infectivity (BSE agent) in the environment
- the possibility that the disease can occur spontaneously

Summary of control measures

Any identified sources of infection have been effectively controlled through the following control measures.

- The positive animal died on farm and was not destined to the food chain. As fallen stock, the entire carcass was category 1 ABP and was appropriately disposed of.
- Rearing cohorts and offspring cohorts were traced, culled and disposed of.
- Surveillance and testing of at-risk animals and fallen stock.
- Elimination of animal proteins from cattle feed as primary route of transmission (reinforced feed ban in effect since August 1996).
- Silo 1 (identified with very low likelihood, high uncertainty as possible source of accidental contamination leading to this BSE case at natal farm) was decommissioned (burned down on farm) in 2017.
- Ban on burying fallen stock (dead animals) on farms since 1 May 2003.
- Effective disposal of SRM as per legislative requirements.

Concluding remarks

Following an epidemiological investigation, 4 potential risk pathways have been identified as most likely source of infection. Each are assessed as a very low likelihood event, with high uncertainty.

1. Potential accidental exposure to contaminated feed concentrates at natal farm (old feed remnants of potentially contaminated feed − before the total feed ban in 1996– that might have remained in silo 1 and that could have accidentally been released in 2017).
2. Potential maternal transmission.
3. Environmental source 1: Potential exposure to previous potential presence of BSE on natal farm via birth products.
4. Environmental source 2: Potential exposure to previous potential presence of BSE on natal farm from on farm or local cattle burials via contaminated groundwater or other pathways.

The likelihood of any other potential risk pathways has been assessed as negligible.

The detection of this case is evidence that the surveillance system for detecting and containing BSE is solid and effective. There is no threat to food safety, to human health or to animal health as a consequence of this case.

The implementation of control measures and continuous monitoring ensures that the risk of BSE agents being recycled within the bovine population has remained negligible.

There is no evidence that any TSE regulations have been breached in this case. There is every reason to believe that current actions will contain any further potential exposure to cattle or the human food chain.

Acknowledgements

The views expressed in this report are those of the National Emergency Epidemiology Group (NEEG). We would like to express our thanks to the TSE experts within APHA, members of the One Health Team and the many other APHA colleagues who have assisted with this investigation.

The NEEG is comprised of staff from APHA’s Veterinary, Operations and Science Directorates.

Appendix 1: Quantitative data used in the assessment of potential sources of BSE in this case

As noted in the report, the approach of EFSA 2017 scientific opinion on BSE cases born after the total feed ban has been followed for the systematic investigation and assessment of potential sources of BSE in this case (Ricci and others, 2017). The report focuses on the plausible transmission routes and the presence or absence of the relevant risk factors. The potential sources are set out in Figure 1. The following data has been considered to assess their likelihood and uncertainties:

1) The BSE agent is highly infectious to cattle

The oral ID_{50} is 0.15g of bovine brain homogenate with confidence intervals of 0.03 - 0.79g (Konold and others, 2012). Assuming bovine brain and spinal cord from a single bovine weigh 750g, then a single brain or spinal cord from a single bovine in late stages of clinical infection would contain 750/0.15 = 5,000 bovine oral ID_{50} units. If dispersed orally across a large number of cows, this could infect 0.69 x 5000 = 3,450 cows (see Gale (2004) for derivation of 0.69 factor).

2) Meat and bone meal from the 1980s was highly infectious to cattle

Epidemiological studies demonstrated meat and bone meal (MBM) as the root cause of the BSE epizootic in the UK in the 1980s. The levels of BSE infectivity in UK MBM produced prior to the ban on the use of brain or spinal cord and offal in the source material for MBM would have been high in terms of bovine oral ID_{50} units. This is evidenced by the large number of BSE cases in the UK during this period.

It should be stressed that the concentration of BSE infectivity in MBM depends entirely on:

- the prevalence of BSE in the cattle offal that went into the rendering plant as source material
- whether or not their brain and spinal cord were included

Thus, there is little point looking for published data on BSE levels in MBM from other countries or for the UK in recent times. There appears to be little data for the UK from the 1980s. However, some estimate can be made from the efficiency of rendering in inactivating BSE infectivity.

TSE-agent strains differ in their heat inactivation properties, that is, their thermostability (Somerville and Gentles, 2011). The BSE agent has a particularly high thermostability compared to the scrapie agent, for example. This enhances its survival in the rendering process by which cattle offal and other ABP, including brain and spinal cord, were converted to MBM. Rendering has been shown to destroy at least 98% of BSE infectivity, such that the reduction is greater than 50-fold (Taylor and others, 1995). Using data from Somerville and Gentles (2011), approximately 1.5 $\log_{10}$ of the mouse-adapted BSE strain 301V infectivity remained at 100ºC (5 bar 10 min) compared to the 3.7 $\log_{10}$ at the lowest temperature studied of 80ºC (see Figure 2d of Somerville and Gentles, 2011). Thus, it is assumed here that rendering achieves a 3.7 – 1.5 = 2.2 $\log_{10}$ reduction back in the 1980s, that is, a 160-fold reduction. This is consistent with the >50-fold achieved by Taylor and others, (1995).

It is estimated that one whole brain or spinal cord from a BSE-infected cow going into MBM feed would infect 3,450/160 = 22 cows, if all that MBM feed were ingested by the cattle herd.

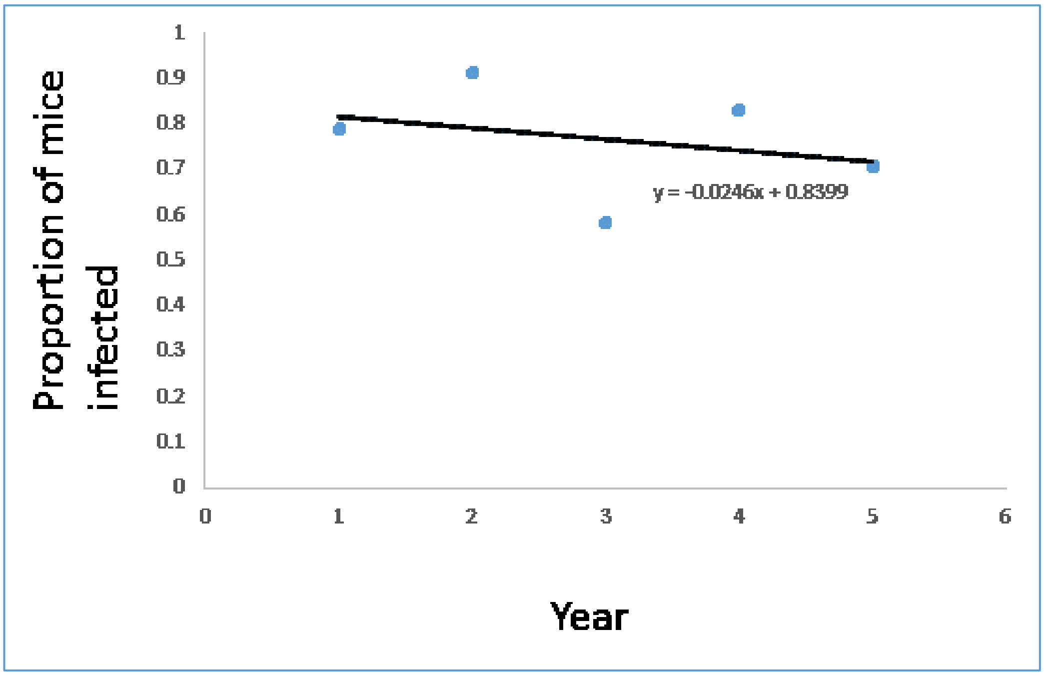
3) BSE infectivity decays very slowly, such that significant proportions would be expected to remain in contaminated material even after 40 years at ambient temperature

Somerville and others (2019) demonstrated survival of BSE agent in cattle heads over a 5-year period. The remaining infectivity was assayed by mouse bioassay. After one year in clay (Figure 2 of Somerville and others, 2019), only ~20% of the mice survived (with incubation periods of around 180 days). While after 5 years, ~40% of the mice survived with incubation periods of round 200 days. This is consistent with very limited decay over the 4-year period. So, if 80% of the mice died at year one and 60% at year 5, then the risk is reduced by about 25% in 5 years. Thus, extrapolating this decay over a 40-year period (that is, from 1980 to 2020), the risk may be reduced ~10-fold, although there is considerable uncertainty in this estimate.

Thus, the one whole brain or spinal cord form a BSE-infected cow going into MBM feed in the 1980s could infect 22/10 = 2.2 cows.

It should be noted that there is considerable variation between the 5 years in the data of Somerville and others (2019) and this 10-fold reduction is perhaps optimistic. Using data from Table 1 of Somerville, the reduction over 5 years is only 15% (Figure 2), giving only a 3.5-fold reduction over the 40 years. The key point is that BSE infectivity was recovered in similar amounts from the heads exhumed annually throughout the 5-year period of the experiment from both clay and sandy soils. Somerville and others (2019) concluded that BSE infectivity is likely to survive burial for long periods of time. It is assumed here that that conclusion applies to BSE infectivity in any contaminated material too.

Figure 1: Proportion of mice infected from six soil samples taken each year from BSE infectivity buried in a bovine skull. Data from Table 1 of Somerville and others (2019)



4) There is no threshold dose for TSE infection (Fryer and McLean, 2011)

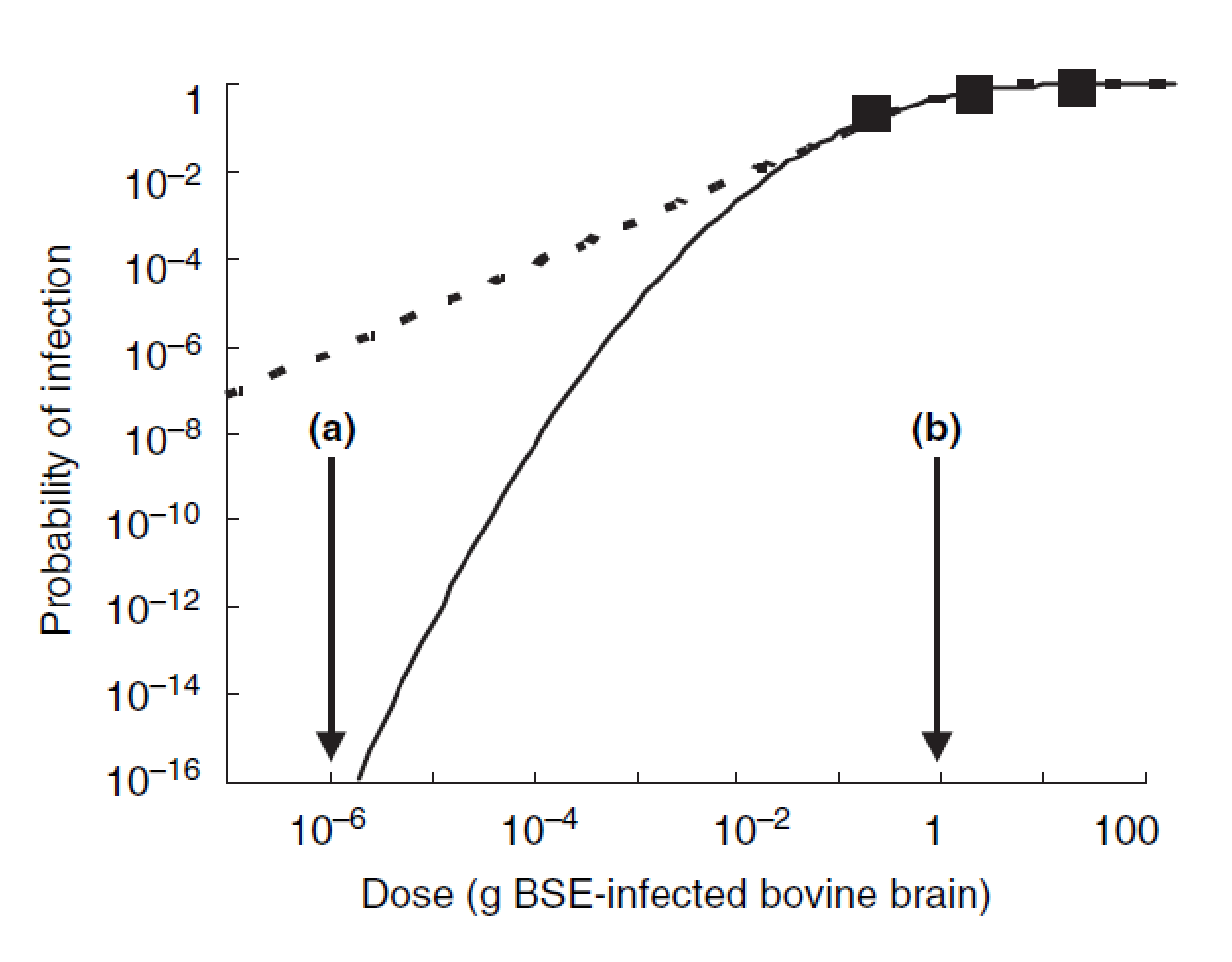
This is an important point because it means that dispersion of the contaminated source by mixing in with other material could not significantly diminish the risk.

Indeed, dispersion of highly infectious pathogens increases the group risk because more animals are exposed, albeit to lower doses. In the absence of a threshold dose, the risk of infection from less infectious pathogens decreases linearly with decreasing dose (see dashed line in Figure 3). This is such that risks from the very small doses ingested by the one or more animals are additive and nothing is lost through dispersion.

In contrast, the risks from low doses if there were a threshold (or cooperative effect, see solid line in Figure 3) are greatly reduced. Adding them up across the exposed population gives a greatly diminished group risk.

Figure 2 shows independent action (dashed line) and cooperative action (solid line) dose-response models fitted to BSE infectivity data in mice (Taylor and others, 1995) and extrapolated to low doses. Point (a) represents the individual exposures through environmental routes, point (b) through food sources. Adapted from Gale (2006).

Figure 2: Proposed BSE dose-response curves for oral exposure in humans.



Above it is estimated that one whole brain or spinal cord form a BSE-infected cow going into MBM feed in the 1980s could infect 2.2 cows in the herd. Much smaller volumes of contaminated material could have been the source of exposure to the case animal. However, because the dose response is linear (with no threshold), these smaller exposures could still initiate infection in the exposed cattle herd albeit with lower risks. For example, just a 50^{th} of a whole brain or spinal cord (that is, 15g) from a clinical case going into the MBM would infect 0.04 cows in the exposed herd. This can be interpreted as a 4% probability of one cow becoming infected, which is a low to medium risk qualitatively.

Thus, even relatively small amounts of contaminated material carry a low to medium risk of one cow becoming infected.

Appendix 2: Summary of relevant TSE control measures and dates

a) The GB National Feed Audit

To confirm the effectiveness of the TSE Feed Ban controls in Great Britain, an inspection and sampling programme called the National Feed Audit (NFA) is undertaken throughout the animal feed chain. This includes imported feeds, bulk storage, production at feed mills, blending plants, and mobile mixers and on-farm mixers at livestock farms, including home compounders.

All incidents are rigorously investigated. Risk-based actions are taken to prevent further marketing of contaminated feed into the feed chain. Where necessary, ruminant animals are restricted and removed from the food chain.

b) The feed ban

Feed controls were first introduced in the UK in 1988, when the cause of BSE was first epidemiologically linked to feed containing meat and bone meal. Since 1988 it has been prohibited to feed ruminant protein to ruminants in the UK. 1 August 1996 is considered as the date of the effective reinforced feed ban when any animal protein was banned from all farm animal feed, with a few exceptions. Read the Guidance note on feed controls in the Transmissible Spongiform Encephalopathies Regulations (GOV.UK). A European Council decision in 2000 (2000/76) extended the ban and provided harmonised BSE-related feed controls across all Member States. Current EU feed ban controls have been amended since then and are included in Regulation (EC) Number 999/2001. This Regulation has been assimilated in domestic legislation as it was on 1 January 2021.

c) Ban on on-farm burial of fallen stock

Since May 2003, it has been illegal to bury fallen stock (dead animals) on farms throughout the EU (of which the UK was a member or continued to adhere to the specific regulations during ‘the transition period’ until 31 December 2020) under the EU Animal By-Products Regulation. A derogation exists within remote areas for burial to occur, however the farm concerned is out with any derogated areas. This prohibition has been retained in UK domestic legislation from 1 January 2021.

d) Testing cattle for BSE

The UK has a robust surveillance programme for BSE, with approximately 100,000 BSE tests undertaken annually. Bovine animals are tested for BSE if they are born in the UK or in an EU country other than Romania or Bulgaria, and the animal is:

- aged over 48 months and showed signs of sickness when examined by a veterinarian before death (ante-mortem inspection)
- aged over 48 months and has been sent for emergency slaughter (for example, casualty animals which do not appear to be unwell, but have broken a leg or suffered some other injury)
- aged over 48 months and is fallen stock, that is, their death was not due to being slaughtered for human consumption
- older than 30 months and killed for the farmer’s private consumption
- a birth or feed cohort of a confirmed BSE case. There is no legal requirement to test the offspring of a confirmed BSE case, but offspring aged under 24 months that are culled and destroyed following confirmation of the case are frequently tested as a precautionary measure

In addition, our surveillance programme requires BSE testing of bovine animals that are:

- slaughtered for human consumption at abattoir if they were born in Romania, Bulgaria, or any non-EU country, and they were older than 30 months and healthy at the time of slaughter
- fallen stock, were sent for emergency slaughter, or showed signs of sickness when examined by a veterinarian before death, that were born in Romania, Bulgaria or any non-EU country, and were older than 24 months at the time of death

e) Disposing of Specific Risk Material (SRM)

SRMs are body parts of cattle or sheep that may contain significant amounts of prion in infected animals. Different animal parts are considered SRM, depending on whether they are of ovine or bovine origin and the age of the animal. SRM is banned from entering the food chain and is removed in abattoirs and disposed of. The removal of SRM is confirmed at a post-mortem inspection.

For a bovine aged over 48 months, the following tissues are classed as SRM:

- the skull, excluding the mandible and including the brain and eyes, and the spinal cord
- the vertebral column, excluding the vertebrae of the tail, the spinous and transverse processes of the cervical, thoracic and lumbar vertebrae and the 11 median sacral crest and wings of the sacrum, but including the dorsal root ganglia
- the tonsils, the last 4 meters of the small intestine, the caecum and the mesentery

Animals are also subject to an ante-mortem inspection on arrival at the abattoir.

In this case, the animal died on farm and was not destined to the food chain. As fallen stock, the entire carcass was category 1 ABP and was disposed of.

f) Culling of cohorts and 'relevant' offspring

Assimilated EU legislation (Regulation 999/2001, Annex VII, Chapter B, paragraph 2.1) and domestic legislation require that the cohorts and 'relevant' offspring are culled. (Relevant offspring are those born in the 24 months prior to the disclosure of the index case.) Strictly only cohorts must be tested, however all relevant offspring identified are also currently tested in GB.

Appendix 3: Definitions

Table 5: Definitions for the qualitative risk terms used in this assessment, based on EFSA (2006) and WOAH (2012) with expanded descriptions adapted from Kahn and others, (1999) and The Food and Agriculture Organization of the United Nations (FAO) (2009)

Risk level	Definition	Expanded descriptions based on (Kahn and others, 1999, FAO, 2009)[1]
Negligible	Event is so rare, does not merit consideration	The chance of the event occurring is so small it does not merit consideration in practical terms. It is not expected to happen for many years, if at all.
Very low	Event is very rare, but cannot be excluded	The event is not expected to occur (very rare), but it is possible. It is not expected to occur within the next 5 years.
Low	Event is rare, but does occur	The event may occur occasionally (rare). It is unlikely to occur within the next 5 years.
Medium	Event occurs regularly	The event occurs regularly. It is possible within the next 5 years.
High	Event occurs very often	The event will happen more often than not. It is expected to occur within the next 5 years.
Very high	Event occurs almost certainly	The event will undoubtedly happen. It is expected to occur within the next 5 years and could happen more than once

[1] The quantitative intervals for each qualitative measure are meant as a guide to assist in either translating quantitative data into a qualitative band for a single parameter or to aid in interpreting the overall qualitative result.

Table 6: Qualitative categories for expressing uncertainty given the available evidence, based on definitions within the literature (EFSA, 2006; ECDC, 2011; Spiegelhalter and Riesch, 2011)

Uncertainty category and definition	Type of information or evidence to support uncertainty category
Low – further research is very unlikely to change our confidence in the assessed risk	Solid and complete data available (for example, long-term monitoring results). Peer-reviewed published studies where design and analysis reduce bias (for example, systematic reviews, randomised control trials, outbreak reports using analytical epidemiology). Complementary evidence provided in multiple references. Expert group risk assessments, specialised expert knowledge, consensus opinion of experts. Established surveillance systems by recognised authoritative institutions. Authors report similar conclusions.
Medium – further research is likely to have an important impact on our confidence in the risk estimate	Some but no complete data available. Non-peer-reviewed published studies or reports. Observational studies, surveillance reports, outbreak reports. Individual (expert) opinion. Evidence provided in a small number of references. Authors report conclusions that vary from one another.
High – further research is very likely to have an important impact on our confidence in the risk estimate	Scarce or no data available. No published scientific studies available. Evidence is provided in grey literature (unpublished reports, observations, personal communication). Individual (non-expert) opinion. Authors report conclusions that vary considerably between them.

Appendix 4: List of cohort animals

Table 7: List of cohort animals.

	Date of birth	Movement Off Date	Location when traced	Results of BSE testing
Cohort 1	31/10/2016	27/06/2018	Incident farm	Negative
Cohort 2	22/01/2017	27/06/2018	Incident farm	Negative
Cohort 3	20/07/2016	27/06/2018	Incident farm	Negative
Cohort 4	28/10/2016	27/06/2018	Incident farm	Negative
Cohort 5	24/10/2016	27/06/2018	Incident farm	Negative
Cohort 6	27/11/2016	27/06/2018	Incident farm	Negative
Cohort 7	31/10/2016	27/06/2018	Incident farm	Negative
Cohort 8	27/10/2016	27/06/2018	Incident farm	Negative
Cohort 9	18/08/2016	27/06/2018	Incident farm	Negative
Cohort 10	21/10/2016	27/06/2018	Incident farm	Negative
Cohort 11	15/09/2017	17/06/2019	Incident farm	Negative
Cohort 12	30/09/2017	17/06/2019	Incident farm	Negative
Cohort 13	28/09/2017	17/06/2019	Incident farm	Negative
Cohort 14	02/05/2017	Not applicable	Natal farm	Negative
Cohort 15	10/09/2017	Not applicable	Natal farm	Negative
Cohort 16	10/01/2016	Not applicable	Natal farm	Negative
Cohort 17	14/05/2017	Not applicable	Natal farm	Negative
Cohort 18	10/05/2016	Not applicable	Natal farm	Negative
Cohort 19	20/07/2016	Not applicable	Natal farm	Negative
Cohort 20	25/09/2016	Not applicable	Natal farm	Negative
Cohort 21	17/09/2017	Not applicable	Natal farm	Negative
Cohort 22	05/11/2015	Not applicable	Natal farm	Negative
Cohort 23	25/03/2017	Not applicable	Natal farm	Negative
Cohort 24	20/09/2017	Not applicable	Natal farm	Negative
Cohort 25	21/05/2017	Not applicable	Natal farm	Negative
Cohort 26	18/04/2016	Not applicable	Natal farm	Negative
Cohort 27	17/07/2016	Not applicable	Natal farm	Negative

Cohort 28	17/05/2017	Not applicable	Natal farm	Negative
Cohort 29	21/07/2016	Not applicable	Natal farm	Negative
Cohort 30	15/04/2016	Not applicable	Natal farm	Negative
Cohort 31	25/11/2016	Not applicable	Natal farm	Negative
Cohort 32	16/09/2017	Not applicable	Natal farm	Negative
Cohort 33	12/10/2016	Not applicable	Natal farm	Negative
Cohort 34	10/05/2017	Not applicable	Natal farm	Negative
Cohort 35	17/04/2016	Not applicable	Natal farm	Negative
Cohort 36	25/04/2016	Not applicable	Natal farm	Negative
Cohort 37	31/01/2016	Not applicable	Natal farm	Negative
Cohort 38	13/10/2016	Not applicable	Natal farm	Negative
Cohort 39	14/10/2016	Not applicable	Natal farm	Negative
Cohort 40	22/09/2017	Not applicable	Natal farm	Negative
Cohort 41	22/11/2016	Not applicable	Natal farm	Negative
Cohort 42	22/10/2015	23/04/2018	Tracing farm 1	Negative
Cohort 43	18/09/2017	12/11/2021	Tracing farm 2	Negative

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