Bovine spongiform encephalopathy in Japan and options for control

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Summary

Since September 2001, Japan has reported to the World Organisation for Animal Health (OIE: Office International des Épizooties) 31 cases of typical bovine spongiform encephalopathy (BSE) and two atypical cases. There were at least two major exposure episodes in Japan. The first, attributed mainly to imported contaminated feed ingredients, occurred between 1995 and 1996 and 13 affected Holstein cows (Group A) were detected in different parts of Japan. The second exposure occurred in Hokkaido, the northernmost island of Japan, between 1999 and 2000. To date, 14 BSE cases (Group B) have been found there. All positive cases of Groups A and B were Holstein cows. The remaining four cases (Group C) were of various ages, including one atypical case of 169-month-old native beef cattle, but the sources of infection are not yet known. Two young (21- and 23-month-old) Holstein steers are also included in Group C, but the transmissibility of these cases has not been confirmed. It appears unique that all confirmed typical BSE cases in Japan have been in Holstein cows, and it could be suggested that future surveillance of BSE in Japan should be focused solely on Holstein cows. It is also suggested that Japan be divided into two zones; Hokkaido zone and the rest. In this way, different strategies could be implemented to achieve eradication within shorter periods of time in respective zones. Since the youngest typical BSE case confirmed in Japan was a 48-month-old cow belonging to Group B, it is suggested that the age of the cattle to be tested at abattoirs be raised from 20 months to 30 months and older. So far, two so-called 'atypical' cases of BSE have been found in Japan, and the author proposes that it is necessary to demonstrate the transmissibility of these cases in order to confirm that they are indeed transmissible spongiform encephalopathies. Further, the author considers it necessary to compare the standards of the national diagnostic laboratory that tests healthy cattle in Japan with those of other OIE BSE reference laboratories in order to demonstrate that current Japanese diagnostic practices meet international standards.

Keywords

Atypical cases, Bovine spongiform encephalopathy, Exposure, Japan, Pithing, Risk communication, Surveillance, Transmissible spongiform encephalopathies, Zoning.

Encefalopatia spongiforme bovina (BSE) in Giappone e scelte per il suo controllo

Riassunto

A partire dal settembre 2001, il Giappone ha riferito all' Organizzazione mondiale per la Sanità animale (OIE: Office International des Épizooties) 31 casi di encefalopatia spongiforme bovina (BSE) tipici e due casi atipici. Ci sono stati almeno due importanti episodi di esposizione all'agente della BSE in Giappone: il primo, attribuito principalmente agli ingredienti per mangimi d'importazione contaminate, si è verificato tra il 1995 e il 1996 e

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sono state scoperte in diversi luoghi del Giappone 13 vacche Frisone affette dal morbo (gruppo A). La seconda denuncia si è verificata in Hokkaido, l'isola più settentrionale del Giappone, tra il 1999 e il 2000 dove fino ad oggi sono stati riscontrati 14 casi di BSE (gruppo B). Tutti i casi positivi dei gruppi A e B erano vacche Frisone. I rimanenti quattro casi (gruppo C) erano d'età diverse, incluso un caso atipico di bovino da carne autoctono di 169 mesi, ma le origini dell'infezione non sono ancora note. Due giovani manzi Frisoni (di 21 e 23 mesi) sono inclusi nel gruppo C, ma la trasmissibilità di tali casi non è stata confermata. Sembra singolare che tutti i casi tipici confermati di BSE in Giappone siano nelle vacche Frisone ed è suggeribile focalizzare una sorveglianza futura per la BSE in Giappone unicamente sulle vacche di questa razza. Si suggerisce, inoltre, di dividere il Giappone in due zone: quella di Hokkaido e il resto del paese, in modo da poter attuare diverse strategie per ottenerne l'eradicazione nelle rispettive zone entro periodi di tempo più brevi. Siccome il caso tipico di BSE più giovane confermato in Giappone è stato quello di una vacca del gruppo B di 48 mesi, si propone che l'età del bestiame da testare ai mattatoi venga innalzata da 20 a 30 e più mesi. Finora, due casi di BSE cosiddetti "atipici" sono stati rinvenuti in Giappone e l'autore propone la necessità di dimostrarne la trasmissibilità per confermare che si tratti realmente di encefalopatie spongiformi trasmissibili. Inoltre, l'autore considera necessario confrontare gli standard del laboratorio diagnostico nazionale che testa il bestiame da macello sano in Giappone con quelli di altri laboratori di riferimento per la BSE dell'OIE, per dimostrare che le attuali pratiche diagnostiche giapponesi soddisfano gli standard internazionali.

Parole chiave
Casi atipici, Comunicazione di rischio, Encefalopatia spongiforme bovina, Encefalopatie spongiformi trasmissibili, Enervazione, Esposizione, Giappone, Sorveglianza, Zonizzazione.

Analyses of bovine spongiform encephalopathy cases in Japan

On 6 August 2001, a cow that was unable to rise without assistance was transported to an abattoir in Chiba Prefecture where it was suspected to be a case of bovine spongiform encephalopathy (BSE). However, confirmation of the diagnosis was not announced until five weeks later. At that time, Japan did not have an active surveillance programme for BSE, and anxiety among producers and consumers escalated rapidly. Furthermore, the public's concern reached panic levels when it was revealed that meat-and-bone meal prepared from this case had been inadvertently distributed to different parts of Japan. The contaminated meat-and-bone meal was promptly withdrawn from the market. Consumer concern over the safety of beef was further exacerbated when, around the same time, some cases of false labelling of beef came to light. Against this background, in October 2001, the Government implemented a programme to test all healthy cattle slaughtered in abattoirs in Japan, describing this as a food safety measure. However, the limitations of the test chosen were not well understood at the time, nor was the actual objective of testing clarified fully.

Field surveillance for BSE also commenced at the same time and, because there were insufficient testing facilities (Livestock Hygiene Service Centres) capable of processing the large numbers planned, a programme to enhance these facilities was implemented and completed by the end of 2003. Following the implementation of this surveillance, the number of BSE cases detected increased each year from fiscal year 2003, and by the end of 2006 a total of eleven had been detected (Table I).

Towards the end of 2001, there was an extravagant media-generated negative public reaction against farms on which BSE cases had been detected. Neighbouring farms, as well as specifically affected farms, also suffered psychological, physical and economic damage (damage from rumour). This negative public reaction had a negative effect on BSE surveillance.

By December 2006, over 6.3 million cattle had been tested and 31 had been found to be BSE-positive. These 31 cases can be broadly classified into Groups A, B and C (Table II) (10). Group A consists of 13 female Holsteins born between 1995 and 1996. As these animals

Table I
Bovine spongiform encephalopathy-positive cattle detected in the field

Fiscal year	Number of animals tested	Number of positive animals
2001, from Oct	1 095	0
2002	4 315	0
2003	48 416	1
2004	98 656	2
2005	95 248	3
2006, to 30 Sept	51 802	4*

* one positive animal was detected on 10 November (which makes the total 11)

Source: Ministry of Agriculture, Forestry and Fisheries, Japan

Table II
Age in months and serial numbers of animals reported to be bovine spongiform encephalopathy-positive in Japan

Report year	Group A*	Group B*	Group C*
2001	64 (1), 67 (2), 68 (3)		
2002	73 (4), 80 (5)		
2003	83 (6), 81 (7)		23 (8), 21 (9)
2004	95 (10), 94 (11), 103 (13)	48 (14)	62 (12)
2005	102 (15), 108 (16), 109 (19)	54 (17), 68 (18), 57 (20), 69 (21)	
2006		64 (22), 68 (23), 71 (25), 68 (26), 68 (27), 80 (28), 75 (29), 64 (30), 84 (31)	169 (24)

* the serial number of each animal is given in brackets

were distributed all over the country, they were suspected to have been infected by contaminated feed (meat-and-bone meal/ tallow) imported towards the end of 1995. Group B consists of 14 Holstein cows born in Hokkaido during 1999-2000. As their distribution was limited to Hokkaido, the source of the infection was suspected to be contaminated feed produced on that island. The incidence of BSE in Group B appears to be peaking at the time of writing. Cattle in Group C are those which have tested positive cases but do not belong in either Group A or B (Fig. 1).

The first BSE case detected in Japan was a 64-month-old dairy animal of Group A. The oldest case found so far in Group A was aged 109 months and there are about 1 700 Holstein cattle of this age cohort currently alive in Japan. The youngest BSE case in Group B was 48 months old and it is considered likely that there could have been undetected BSE cases in Japan during 2000, although the first case was detected only in the summer of 2001. It is also likely that more Group B cases will appear during the next three to four years, but these are likely to be confined to dairy cattle born in Hokkaido.

In Group C, two young animals (21 and 23 months old) were male Holsteins born in Honshu (Tochigi and Hyogo Prefectures). They were detected through tests conducted in October and November 2003. These animals were born after the use of ruminant-origin proteins in cattle feed was banned in October 2001. If these young animals had indeed been infected with BSE, there is a possibility that they had been fed a relatively large amount of the prohibited ruminant-origin protein. However, epidemiological investigations have not found any evidence of this. The question arises, why were only these two young positive animals detected, within a period of one month? Also, why has transmission of experimental infection to mice not occurred after more than two years? Transmissibility of the disease must be proven before these unusual cases can officially be called BSE. If these two young animals had been exposed to large amounts of the BSE agent around January 2002, there should have been other BSE-positive animals detected amongst their cohorts, especially as more than five years have since elapsed. These areas of uncertainty mean that it is essential that the Japanese authorities demonstrate conclusively that there was no problem with the diagnostic techniques which produced positive test results for these cases. Unconfirmed 'positive' results in such young animals have the potential to become an international issue where trade in bovine products is concerned.

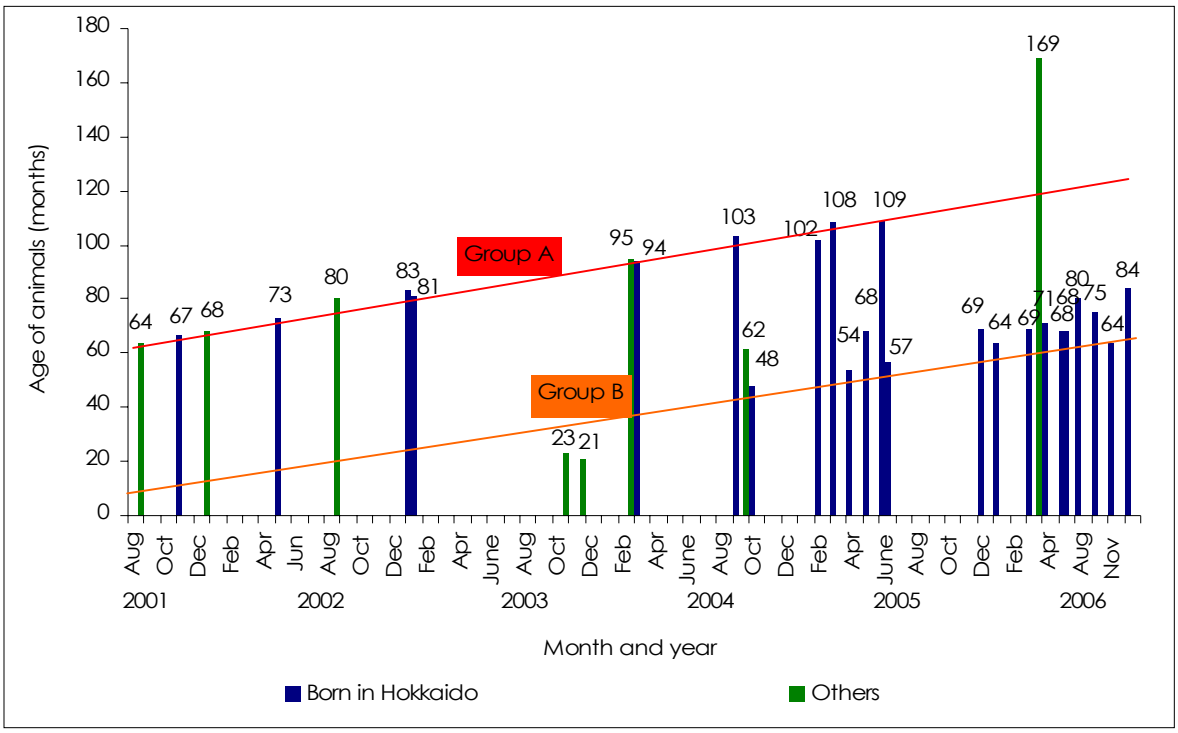

Figure 1
Bovine spongiform encephalopathy-positive animals in Japan, showing age (months) and year and month of report

In March 2006, a 14-year-old native beef animal of the Wagyu breed was reported to be positive for BSE. It is unlikely that the BSE prion was present only in Nagasaki around 1992, when this animal was born there. No epidemiological evidence corroborating a diagnosis of BSE has been reported for this 'case'. Furthermore, the abnormal protein band pattern detected in Western blotting (WB) was reported to be somewhat different from the pattern of true BSE. For this reason, it is important that the authorities ascertain whether this particular case is of the Italian type or French type atypical BSE or some other abnormal protein. A similar positive case was reported in 2003 in a 20-year-old Wagyu (born in 1983, in Shimane Prefecture). However, as this animal was born before BSE was first detected in the United Kingdom, the investigating authorities excluded it from the Japanese BSE cases.

Three hypotheses have been proposed to explain the origin of so-called 'atypical' cases of BSE, as follows:

a) a genuine BSE prion has transformed its structural form within an infected cell
b) several strains of scrapie prion infected a bovine simultaneously, and formed a new strain (atypical BSE prion)
c) as is commonly believed to occur in sporadic Creutzfeldt Jakob disease (CJD) in humans, there are sporadic forms of BSE in cattle.

Of these theories, (b) seems to be most common and (c) cannot be proven.

Considering what has been reported from the investigations, the BSE situation in Japan can be summarised as follows:

a) So far, there have been at least two major episodes of exposure to BSE-contaminated feed. In the first, the contaminated feed was distributed across the country around 1996 causing the Group A infection. The second episode occurred in Hokkaido around 2000 and resulted in Group B infection. The Group B animals could be further subdivided, as they show slight variations in age.
b) As all the animals in Group A (13 head) and Group B (14 head) were female Holsteins, the contaminated feed was probably fed mainly to dairy cows.

c) The two young animals and the 14-year-old Wagyu could not be confirmed as true BSE cases on the basis of data reported to date. More data are required before they can be internationally recognised as genuine BSE cases. The source of contamination also needs to be re-examined for the 12th case (62 months old).
d) BSE-contaminated feed was probably fed only to dairy cattle in Japan. Therefore, the objective of the surveillance could be achieved more efficiently in future by testing only adult dairy cows.
e) Among the 27 cattle in Japan unequivocally accepted as genuine BSE cases, the youngest was a 48-month-old cow belonging to Group B. This strongly suggests that the purpose of BSE surveillance in Japan could be achieved appropriately by testing healthy cattle according to the European Union (EU) standard (over 30 months) or the World Organisation for Animal Health (OIE: Office International des Épizooties) standard (over 36 months).

In light of the above, it appears essential that the BSE risk in Japan be reassessed and the ongoing measures against BSE be reviewed, after reconfirming that all the cases reported in Japan are, indeed, genuine BSE. Japan's exit from the list of BSE-affected countries depends on how quickly the BSE contamination in Hokkaido can be cleared. For this, Japan needs to identify the most efficient measures, such as replacing six-year-old and older dairy cattle in Hokkaido with younger cattle as quickly as is feasible. It is also necessary to concurrently reassess the risks in the entire feed production system to completely safeguard cattle feeds of the country, particularly in Hokkaido, from the risk of BSE contamination.

Bovine spongiform encephalopathy surveillance

Surveillance in Japan

As a measure to protect consumers, in October 2001, the authorities in Japan implemented a programme of BSE testing for all slaughtered healthy cattle. However, the limitations of the rapid test and the aims of BSE surveillance carried out in the EU were not well understood in Japan at that time.

For example, the authorities in the EU were aware that there was almost no possibility of detecting BSE-infected animals through testing cattle younger than 30 months of age. For this reason, they considered that testing of animals 30 months or older provided practicable, adequate surveillance (6). In Japan, on the other hand, a decision was made to test **all** cattle at abattoirs, in the mistaken belief that this would provide 'the most stringent safety measure in the world'. This was the beginning of 'the baseless testing of all the slaughter cattle' in Japan. More unfortunately, some cases of false labelling of beef came to light around that time, and consumer distrust in the safety of beef from animals of unknown age and place of production was amplified. The result was that the consumers were persuaded that any beef that had not passed the rapid test for BSE was unsafe, and many consumers still hold this belief.

These points have been made clear in publications where the author has stated that it is meaningless to test all healthy young cattle by the rapid tests (7, 8, 9). A major argument against such testing is that tissue from the brain stem (the obex) is used for testing and the BSE agent takes about 30 months to reach the obex from the ileum via the nerve tissue. Thus, testing brain tissues before that time provides absolutely no assurance of safety. Moreover, the BSE prion reaches detectable titres in the obex tissue only in the last 3~6 months before an infected animal develops clinical signs. Testing before this time will, therefore, give negative results even in cases when an animal is infected.

However, in Japan's active BSE surveillance programme, it was not only apparently healthy cattle arriving at abattoirs that were tested: from October 2001, testing was also extended to animals in the field which showed clinical signs suggestive of BSE.

By the end of December 2006, a total of 6 475 015 cattle had been tested. The enzyme-

linked immunosorbent assay (ELISA) found 164 positive cattle, but only 31 of 164 tested positive in the confirmatory tests (WB and other) (Table III).

From August 2005, the authorities announced that only 21-month-old and older cattle needed to be tested if they appeared healthy. In the field surveillance for BSE, many of the Livestock Hygiene Service Centres were not equipped with the necessary safety facilities and incinerators when the first case of BSE was diagnosed in 2001 and, for this reason, the enforcement of countrywide compulsory testing was delayed until April 2004. A number of infected animals could have been clandestinely disposed of in the meantime.

In recent years, the average incubation age of BSE-positive animals has gradually increased. Therefore, it would be appropriate to conclude that the youngest true BSE case in Japan was the 48-month-old animal detected in Group B (rather than the 21-month-old case mentioned earlier, the transmissibility of which has not been proven). It follows from this that the mandatory testing age in Japan could be changed to 30 months and older as in the EU, or even 36 months and older, without sacrificing either sensitivity of surveillance or the protection afforded to consumers. In the OIE standard also, the testing of routine slaughter cattle in abattoirs is mandatory only for 36-month-old and older cattle (5).

World Organisation for Animal Health surveillance standard

The OIE has divided countries into the following three categories, based on BSE risk assessment:

- countries with **negligible BSE risk** (the necessary measures against BSE are in place)
- countries with **controlled BSE risk**, having BSE infection, but with the necessary countermeasures in place
- countries with **undetermined BSE risk** (no surveillance being conducted).

Measures to be adopted by countries of each category were given in detail in a previous publication (10). The OIE standard for active BSE surveillance in countries where the disease is present recommends considering cattle as falling into the four following subpopulations for the efficient detection of BSE-infected animals:

- cattle with clinical signs suggestive of BSE (aged 30 months or older)
- cattle that were emergency slaughtered because they were unable to rise or walk (downers) (aged 30 months or older)
- fallen stock, which had died of unknown causes (aged 30 months or older)
- healthy cattle for routine slaughter (aged 36 months or older).

Each subpopulation is further divided according to age group, and points assigned

Table III
Results of rapid tests (ELISA) for bovine spongiform encephalopathy in Japan (18 October 2001-31 December 2006)

Fiscal year	Cattle with symptoms		Cattle aged 30 months or more		Other cattle		Total	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
2001	1 851	0	215 529	19	306 152	40	523 532	59
2002	2 970	3	517 744	23	733 053	18	1 253 767	44
2003	6 264	2	494 983	4	751 370	7	1 252 617	13
2004	8 307	3	472 713	12	784 581	15	1 265 601	30
2005	7 470	0	465 726	7	759 047	2	1 232 243	9
2006, to 31 Dec	5 320	1	380 660	6	575 216	2	984 408	9
Total	32 296	9	2 547 359	71	3 909 417	84	6 474 851	164*

* a total of 164 animals were positive using the enzyme-linked immunosorbent assay (ELISA), but only 31 of 164, including 2 atypical cases, were found to be positive after confirmatory Western blotting tests

Source: Ministry of Health, Labour and Welfare, Japan

for each BSE case should be recorded (Table IV). The total points must satisfy the prescribed minimum (5).

In the OIE *Terrestrial animal health code*, surveillance is divided into two types, Type A and Type B.

Type A surveillance

Type A surveillance is appropriate for countries where BSE is present but which have the necessary measures in place against the disease. In this type of surveillance, the sensitivity of the programme is designed to detect with 95% confidence a prevalence of one positive animal in 100 000. In a country with 1 million or more adult (aged 2 years or more) cattle, for instance, a total of at least 300 000 points are required to prove that the country has an effective surveillance system.

Type B surveillance

Type B surveillance is for countries with negligible BSE risk and which could be effectively considered as BSE-free countries. A minimum of 150 000 surveillance points are required to maintain negligible risk status.

A country such as Japan, which is a BSE-affected country with over a million adult cattle, requires OIE Type A surveillance to generate a minimum of 300 000 points. For a BSE-free country with the same adult cattle population, Type B Surveillance generating 150 000 points would be sufficient to maintain status (5).

In situations where healthy cattle aged 24 months or less are tested, points gained are only 0.01 per head, and 30 million cattle would have to be tested to accumulate 300 000 points. This would be a very inefficient, not to say irrational, method of surveillance. In contrast, testing a single 4 to 7-year-old animal displaying clinical signs suggestive of BSE would yield points equivalent to testing 7 500 routine slaughter cattle in the 2 to 4-year-old age group. Thus, this is a much more efficient method of surveillance. This suggests that the testing of young routine slaughter cattle aged 30 months or less, however large the number, is of extremely limited value in so far as BSE surveillance is concerned.

The problem of atypical cases

As with many other diseases, when a large number of specimens are examined and as new tests are developed, some specimens may be expected to show atypical or non-specific reactions. Further, new variants of the disease may be discovered. Experience has shown that BSE is no exception. Until about 2000, it was believed that all BSE agents were of the same type (strain) (3). However, it has recently come to light that, apart from genuine BSE, there are also atypical variants (2, 3).

Around 2003, variant prions showing characteristics different from genuine BSE were discovered when bovine prion diseases were investigated by the WB and histopathological tests. In Japan, two apparently atypical cases have been found amongst the 31 reported positive cases. The first atypical case was reported in October 2003 (No. 8 case) and the second in March 2006 (No. 24 case) (11).

Presently, at least two strains of 'atypical' bovine abnormal prion proteins, i.e. H-type and L-type, are distinguished by the WB method. The H-type has been found in France,

Table IV
Point values for Type A surveillance of bovine spongiform encephalopathy*

Target cattle for testing / Age of animal	Routine slaughter animals (abattoirs) (36 months and older)	Fallen stock (30 months and older)	Downers and emergency-slaughtered animals, (30 months and older)	Clinical BSE suspects (30 months and older)
2-4 years	0.1	0.2	0.4	260
4-7 years	0.2	0.9	1.6	750
7-9 years	0.1	0.4	0.7	220
9 years and older	0.0	0.1	0.2	45

* according to OIE (World Organisation for Animal Health) standard

Sweden, Poland and the United States, and the L-type in Germany, France, Belgium, Italy and Japan. These two types are differentiated mainly on the basis of molecular weight and the glycoform profiles in the WB test, and the susceptibility of mice to the agent. It has been reported that the H-type is seen more often in older cattle (2), and some researchers have hypothesised that it is a new prion strain that differs from the original, typical BSE strain (3). L-type prions seem to show higher infectivity in monkeys by intracerebral inoculation.

'Genuine BSE' is the disease that develops in cattle fed with feeds contaminated with the typical BSE agent. Whether atypical BSE is caused by something other than the BSE agent or whether atypical prions are found exclusively in older cattle has not yet been clarified. However, more cases of non-specific reactions and atypical BSE variants can be expected to be discovered in the future as more cattle are examined by current and newly developed rapid tests. In addition to the rapid test, epidemiological validation and transmission studies in animals are necessary to decide whether a case is genuine BSE or not. It could be argued that so long as atypical BSE cases are reported to OIE as ordinary (or 'genuine') BSE cases, Japan will probably never be able to get off the list of countries where BSE is present.

It is probable that national diagnostic laboratories in Japan have used antibodies or different concentrations of reagents different from those used in the WB tests employed in Europe. The EU has its own standards, and arbitrary changes in testing procedures would not be permitted. In the case of Japan, there is no system in operation to accredit or evaluate the quality assured services of national diagnostic laboratories. Therefore, it is not clear where the 'gold standard' is and how different it is from the EU or OIE standards. In the future, it will be necessary for Japan to strengthen liaison with other OIE reference laboratories, decide as quickly as possible on the methods of differentiating genuine BSE from the atypical strains, and decide to adopt a world standard for diagnosis. Confirmatory reports to the OIE should be made after deciding on the proper standards and ascertaining whether the BSE case was typical or atypical. In any circumstances, continuation of the needless testing of young cattle not only entails colossal economic loss but also could confuse future eradication measures and delay Japan's attaining BSE-free status.

Problems with Japan's measures against bovine spongiform encephalopathy

Safety measures and their economic efficiency

According to a risk analysis (13), 'not even one person' (roughly 0.1-0.9 person) out of the Japanese population of 127 million is at risk of contracting a BSE-related infection. In spite of this, to date, Japan has spent about 400 billion yen (US$3.43 billion) of taxpayers' money for the programme. In addition, there has been the colossal loss of more than 600 billion yen (US$5.14 billion) incurred to consumers and the service industries because of the rise in price of beef and non-availability of inexpensive beef. The total economic loss for Japan excluding the labour cost has been assessed as about a trillion yen (US$8.56 billion) (1). The scientific rationale given by Japanese officials for spending more than a trillion yen on a disease that would not cause even a single human casualty, and for strongly demanding that other countries also spend money in a similar manner, is not scientifically justifiable.

It behoves officials to examine carefully the reasons why such an irrational situation has arisen and to review the adopted measures as early as possible. The following points require particular attention:

a) The risk of BSE entering Japan was very high in 2000, but Japan ignored the advice of the EU, and did not adopt emergency measures.
b) In western countries, preparedness is considered to be a part of the response to risk and is generally funded, at least to some extent, in advance of crises arising. On the other hand, in Japan, budgetary

allocation is not usually made until an emergency situation arises.

c) 'Risk communication', i.e. a system for providing information on BSE risk and other relevant matters, was not introduced in Japan until after the first case of BSE was discovered in the country. Therefore, consumers and other stakeholders were greatly shocked and significant loss was caused by rumours. In addition, there were not enough experts who could handle risk communication in a professional manner.

d) In spite of Japan not having sufficient experts with specialist knowledge of BSE in 2001, the government was unwilling to listen to the advice of foreign experts in the early stages of epidemics. Instead, a large number of politicians went to Europe and repeatedly asked the same questions, causing consternation and embarrassment there.

e) While recognising that its decision to implement 'blanket testing of all slaughter cattle' was a political one, the government made its decision without thoroughly examining the limitations and reliability of rapid tests for BSE. Credibilty was stretched by the government's unfortunate boast that the testing programme was the most stringent meat safety measure in the world.

f) Most Japanese scientists who serve on expert committees are experts on pathogens and work mainly in laboratories. Few have expertise in epidemiology or are disease control specialists well versed in BSE control. Moreover, they lack expert knowledge or first-hand experience of abattoirs or meat processing plants.

g) It is usual pracrice in western countries for the economic effect (cost/benefit analysis) to be considered before adopting disease control measures, whereas in Japan this aspect is often neglected because of a prevailing belief that government will automatically step in at the time of an emergency. In addition, consumers assume that food safety measures 'are free'.

h) Japanese consumer organisations have a strong tendency to demand 'zero risk', ignoring economic efficiency or, indeed, what is realistically attainable. They often demand a political or emotional response, rather than a scientifically and economically appropriate one. Because of this attitude, an appropriate response to a situation may not be implemented due to government trying to satisfy the unrealistic or ill-informed demands of politicised consumer organisations.

It is important that Japanese authorities develop and implement well-designed contingency plans for future animal disease or food safety issues of the kind that arose as a result of BSE. Such preparedness should address the training of risk communication experts, the assigning of appropriate roles to scientists and politicians, the application of economic and epidemiological analysis (cost versus benefit) and the employment of foreign experts, so that the same mistakes are not repeated in future emergencies.

Problems with abattoirs and meat processing plants

Research in various EU countries has elucidated the distribution of the BSE agent within the body of the infected animal. The distribution of BSE infectivity in an infected cow has been shown to be approximately 64.1% in the brain, 25.6% in the spinal cord, 3.8% in the dorsal root ganglia, 2.6% in the trigeminal ganglia, 3.3% in the ileum, 0.3% in the spleen and 0.04% in the eyes, which accounts for a total of 99.74% of the agent in an infected bovine (12).

In meat processing plants in the EU, the tonsils and intestines are removed from all cattle slaughtered, and the brain, spinal cord, vertebral column (dorsal root ganglia), eyes and skull are also removed as risk materials from animals aged 30 months or older.

On the basis of the the infectivity distribution data, the OIE has formulated an international standard on the risk materials from BSE-infected cattle. This standard imposes the following restrictions for BSE-affected countries like Japan:

- carry out ante-mortem inspection of all animals before they are allowed to enter the

abattoir, and slaughter only the healthy animals
- ban the use of pithing, methods of slaughter that disrupt brain tissue and result in emboli of brain tissue being distributed through the bloodstream to contaminate other tissues
- remove and destroy the tonsils and distal ileum from animals of all ages
- remove and destroy the brain, spinal cord, eyes, skull, vertebral column and dorsal root ganglia from animals aged 30 months or more
- ban the use of mechanically recovered meat from cattle aged 30 months or older.

There are some features in Japanese abattoirs that do not satisfy these OIE safety measures. These relate to the methods of humane slaughter. While BSE-affected countries other than Japan have completely banned the use of air injection stunning and pithing, a survey conducted at the end of 2004 found that stunning was still used in 149 and pithing in 115 out of 160 abattoirs surveyed in Japan.

Recent survey results on pithing are shown in Table V. Estimates based on these results suggest that about 65% of the abattoirs would stop using pithing by the end of March 2008, about 97% by April 2008 and 100% by the end of March 2009 (announced in January 2007 by the Ministry of Health, Labour and Welfare). Abattoirs fall under the jurisdiction of local government bodies in Japan and discussion about them is often ethical taboo. Therefore, changes would only come gradually. It is difficult to understand why pithing, which directly affects consumer safety, cannot be stopped at once. Unless there is full enforcement of this rule, it is impossible to ensure that Japanese beef is safer than European or American beef. This fault needs to be addressed urgently. Another problem is the fact that the vertebral columns are removed outside the meat processing plants. Removing the most risky materials outside supervised meat processing plants poses serious problems in safety management.

Proposals for improving surveillance in Japan

There are about 4.3 million cattle in Japan, and about a half of them are Holstein cattle. As mentioned previously, it is irrational to continue the blanket testing of all slaughter cattle. Four alternatives are proposed below.

Testing of routine slaughter cattle

Pithing disrupts parts of the brain and spinal cord (brain stem). Therefore it is very likely that samples needed for rapid testing are also disrupted. The OIE *Manual* (4) suggests taking brain stem samples in the form of cross-sectional slices. In Japan, however, at many testing locations, the test specimens are sampled with syringes. Consequently, the exact location of the sample's origin is often unknown. The test may give a false-negative result unless the tissue is collected from the appropriate site. Therefore, the pithing of any animals that are to be tested should stop immediately. Testing animals can be safely restricted to those aged 30 months or older for the reasons described earlier. What is urgently needed is to sample the test specimens in accordance with the international standard.

Animals to be tested

The genuine BSE cases detected in Japan (in Groups A and B) were all dairy cows (female Holsteins). Therefore, the purpose of surveillance would be achieved adequately by testing only dairy cattle (Holsteins) aged 30 months or more. Animals giving positive

Table V
Number and proportion of abattoirs that use pithing in Japan

Date	Abattoirs that use pithing	Abattoirs that have stopped use of pithing	Abattoirs reported
End of October 2004	115 (72%)	45 (28%)	160
End of September 2005	93 (58%)	68 (42%)	161
End of February 2006	82 (51%)	79 (49%)	161
End of October 2006	64 (40%)	95 (60%)	159

Source: Ministry of Health, Labour and Welfare, Japan, January 2007

results must, of course, be destroyed. One Japanese black (Wagyu) in Group C reportedly had atypical BSE. However, unless inoculation studies on samples from this animal demonstrate transmissibility, there is no need to routinely test clinically healthy Wagyu cattle (this was a single atypical case found after testing more than 6.3 million cattle). There are a total of about 1.7 million Holstein cows in Japan. About half of them (about 850 000) are situated in Hokkaido. Therefore, if a regional approach is taken, the number of animals to be tested in the Honshu region would be reduced significantly.

Regional measures against bovine spongiform encephalopathy

Japan could be divided into two zones, Hokkaido and the rest, and appropriate measures formulated for each zone. In the non-Hokkaido zone, the remaining Holstein cattle of the same age as Group A number about 17 000. A policy for early disposal of these animals should be developed (taking the cost and benefit into account). It is broadly estimated that the Hokkaido zone would still have about 60 000 head of Holsteins of the age of Group B, and it would be necessary to find out how rapidly these cattle could be disposed of using safe and economically advantageous methods. Japan cannot become BSE-free until all the BSE cases in Hokkaido are eliminated. Therefore, anti-BSE measures in Hokkaido must be reinforced in a focused manner. During this time, the transportation of dairy cattle born in Hokkaido to other regions must be stopped or limited to those that are below 60 months of age. In addition, the risks associated with all parts of the distribution system, including abattoirs, meat processing plants, chemical plants, incineration plants, feed processing plants, fertilizer factories, agricultural cooperatives, etc., need to be reassessed in an open and transparent manner.

The problem of suspect animals

Presently, once a BSE-positive case is detected, all cattle with a history of having shared living space with the infected animal within one year of its birth, cattle born on the same farm within a year before or after the birth of the infected animal, and calves born within two years before the infected animal showed disease onset or after disease onset are culled. Such suspect animals are currently tested by the rapid test, but in Japan, in common with nearly every other country where BSE has occurred, no BSE case has been detected amongst them. Is it necessary to continue the measures? If such removal and testing of cohorts is to be maintained, the restriction should apply solely to dairy cattle.

The authorities in Japan need to formulate appropriate national surveillance policies after thorough scientific, epidemiological and statistical examination of all Japanese and global data relevant to BSE.

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