Bovine spongiform encephalopathy surveillance in the Republic of Korea

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Summary

National surveillance for bovine spongiform encephalopathy (BSE) began in the Republic of Korea (ROK) in 1996. Surveillance programmes changed over time to comply with the guidelines of the World Organisation for Animal Health (OIE). Bovine spongiform encephalopathy was designated as a notifiable disease in 1997. From July 2008, the BSE surveillance programme was intensified to test cattle in designated high-risk populations more effectively. New measures included the compulsory testing of all non-ambulatory cattle at abattoirs, and encouraging the testing of all dead cattle examined and recorded under the Mutual Aid Insurance Scheme (fallen stock). In addition, there was a vigorous search for animals suspected of being clinically infected. As a result, a total of 426,919 OIE points were achieved over a period of seven consecutive years to the end of October 2009. This enabled the submission of a successful application to the OIE in 2010 for recognition of the ROK's BSE disease status as being one of controlled risk, in accordance with Chapter 11.5. of the OIE *Terrestrial Animal Health Code*.

Keywords

BSE – Bovine spongiform encephalopathy – Korea, Republic of – Republic of Korea – Surveillance – World Organisation for Animal Health (OIE).

Introduction

Bovine spongiform encephalopathy (BSE) is a neuro-degenerative disorder which belongs to a family of diseases called transmissible spongiform encephalopathies (TSEs) (16). It mainly affects cattle, although natural infections have also been identified in captive wild ungulates and felines, as well as domestic cats (14). Two cases have been confirmed in goats (4, 7). Since its first identification in 1986 in the United Kingdom (UK), approximately 190,000 cases of BSE have been reported worldwide (20). The recognition in 1996 of a probable link between BSE in cattle and variant Creutzfeldt-Jakob Disease (v-CJD) in humans alerted the world to the potential public health implications of the disease (17). A national surveillance programme for BSE was initiated in the Republic of Korea (ROK), based upon histopathological examination of the brains of suspected bovine cases. The designation of BSE as a notifiable disease provided a legal base for further surveillance. The chronology of key developments in the ROK surveillance programme is summarised in Table I (9, 12).

An application was made to the World Organisation for Animal Health (OIE) in 2007 for recognition of the country's BSE disease status, in accordance with the scientific model for the evaluation of BSE surveillance systems (BSurvE), as adopted by the OIE (13, 19). At the time of submission to the OIE, the ROK had not yet attained the target of 300,000 points required under Type A surveillance (point values are assigned to surveillance samples according to the likelihood of detecting infection based on the subpopulation from which the sample was collected and the age of the animal sampled). Furthermore, gaps in the data on the potential for importation of BSE in contaminated commodities and the need for a review of internal control measures meant that the surveillance points acquired at the time were insufficient to allow BSE

Table I
Major strategies for bovine spongiform encephalopathy control in the Republic of Korea

Date	Measures
August 1996	Active surveillance
June 1996	Administrative guidance on feed ban on meat-and-bone meal and greaves for ruminants
May 1997	Bovine spongiform encephalopathy (BSE) designated a notifiable disease in the Act for Prevention of Livestock Epidemics
March 2001	Feed ban on ruminant-derived protein for ruminants in the Act for the Control of Livestock and Fish Feed
July 2001	Immunohistochemistry and western blotting method for confirmatory diagnosis established at the National Reference Laboratory (1, 18)
January 2002	Rapid testing (Bio-Rad TeSeE®) introduced for effective active surveillance
March 2002	A contingency plan specific to transmitted spongiform encephalopathies (namely, BSE, scrapie and chronic wasting disease) established
July 2008	Enhanced BSE surveillance programme introduced
December 2008	Bovine traceability system at production and market distribution level is introduced
December 2008	Feed ban on terrestrial animal-derived protein for ruminants in the Act for the Control of Livestock and Fish Feed
March 2009	A contingency plan specific to BSE established

risk within the ROK to be categorised. In response, the OIE emphasised the importance of supporting applications with appropriate surveillance data, and requested that a total of at least 300,000 OIE points be achieved before re-application. As a result, an enhanced BSE surveillance programme was designed and implemented from July 2008. In this paper, the main components of the enhanced surveillance programme are fully described and discussed.

Materials and methods

Cattle population structure

From 2003 to September 2009, Korean native cattle and non-indigenous beef cattle represented 75% (range: 66% to 81%) of the total cattle population, while 25% (range: 19% to 34%) were dairy cattle (11). This small proportion of dairy cattle in the national herd is because dairy products are not popular in the traditional Korean diet. While adult cattle populations were much smaller in the cities than in provinces, the proportion of dairy cattle was greater. The average size of the adult cattle population (over 24 months of age) for the (almost) seven-year period between 2003 and 2009 was 1,086,354 (range: 863,233 to 1,340,614) (Table II). The number of beef cattle doubled from 2003 to 2008. This was a direct result of prohibitions on the importation of beef from Canada and the United States (USA) in May and December of 2003, respectively, due to the diagnosis of indigenous BSE in each country. This resulted in an increased internal demand for domestically produced beef, and the industry grasped the commercial opportunities offered (10).

Assessment of ages sampled

Regulations that required the ability to identify individual cattle, in particular their ages, came into effect on 22 December 2008. In the absence of documentation that gave an accurate indication of age when cattle were presented for slaughter or examination, alternative administrative approaches were adopted, in addition to dental checks. Although these approaches were recognised as not being able to accurately determine age, they did increase confidence in the estimated age distribution of the animals being tested.

Table II
Population statistics for adult cattle (over 24 months of age)
Source: Ministry for Food, Agriculture, Forestry and Fisheries, Republic of Korea (11)

Year	Korean native cattle or beef cattle	Dairy cattle	Total
2003	567,847	295,386	863,233
2004	647,707	285,671	933,378
2005	709,762	273,681	983,443
2006	814,994	265,653	1,080,647
2007	889,383	257,865	1,147,248
2008	1,005,029	250,885	1,255,914
Up to and including September 2009	1,091,195	249,419	1,340,614
Average	**817,988**	**268,366**	**1,086,354**

Unit: head of cattle

Estimates of high-risk populations

In general, the highest risk categories and preferred targets for BSE surveillance are adult cattle that show clinical signs involving the central nervous system, and dead and non-ambulatory cattle with clinical signs that cannot be adequately evaluated. Since accurate data were not available for the number of casualty-slaughter and fallen stock in the country, the respective populations were roughly estimated, to establish a strategy to improve BSE surveillance.

The number of casualty-slaughter animals

During the first nine months of 2009, a total of 638,383 cattle (504,781 Korean native cattle; 44,545 dairy cattle; 89,056 beef cattle and one imported cattle beast) of all ages were slaughtered for human consumption (11). There were a total of 81 slaughtering facilities in the country at that time (11).

At the end of 2006, cities and/or provinces were asked to submit data on the numbers of casualty-slaughter animals recorded during the previous three years. For the years 2004, 2005 and 2006 (up to and including November), the number of casualty-slaughter animals recorded were 4,003, 5,712 and 4,050, respectively; an average of 4,588 per year. This average conceals considerable variability in the numbers of casualty-slaughter cattle recorded by abattoirs, which is partly due to slaughter throughputs, but also to the reluctance of many abattoirs to accept such cattle.

The number of fallen stock

As there were no statistics on the numbers of fallen stock in the country, it was necessary to estimate the size of the target population by using data from the Mutual Aid Insurance Scheme, a programme introduced by the National Agricultural Cooperative Federation (NACF) in 1997. Under this scheme, the deaths of cattle on a farm that are due to diseases other than notifiable diseases or accidents, or due to casualty slaughter as a result of calving difficulties or bloat, trigger the payment of compensation in accordance with the scheme's rules. Submissions require prior certification by a veterinarian. According to data from the NACF, the number of adult cattle eligible for mutual aid insurance increased steadily from 2005 to 2008 (range: 118,251 to 169,925). The number of dead adult cattle examined and recorded under the scheme also increased between 2005 and 2008 (range: 8,855 to 19,240).

The number of potential 'fallen stock' identified by this approach suggested a mortality rate, using the 2008 data, of approximately 11% of adults. Extrapolated to the national herd, this would suggest that the population of adult fallen stock available for sampling was approximately 140,000.

Designation of samples collected during enhanced surveillance

Bovine spongiform encephalopathy surveillance data are categorised in accordance with the OIE *Terrestrial Animal Health Code*'s definitions, as summarised in Table III. Interpretation of the OIE guidelines was influenced by an unequivocal statement made by the OIE Reference Laboratory at the Veterinary Laboratories Agency (VLA), UK, that recumbent cattle should be considered as BSE suspects unless an alternative cause of recumbency could be clearly established (15). Therefore, on the farms, downed or 'downer' cows were classified either as clinical suspects (down of unknown cause, but displaying evidence of over-reactivity) or as fallen stock (down of a known cause).

Enhanced bovine spongiform encephalopathy surveillance programme

The BSE surveillance programme involved the establishment of national annual targets for OIE points, which were announced early each year. The TSE National Reference Laboratory (NRL), Animal, Plant and Fisheries Quarantine and Inspection Agency (QIA), subsequently ordered the initiation of an 'Annual TSE Surveillance Programme' in 16 cities and/or provinces. Detailed instructions, including OIE points targets, were assigned to each city and/or province, by targeted population, and included details of the approved sampling methods, and,

Table III
Definitions of each stream of cattle and categorised results of Korean bovine spongiform encephalopathy surveillance data

Stream	OIE *Terrestrial Animal Health Code*	Korean BSE surveillance data categorised to this stream
Clinical suspects	Cattle over 30 months of age displaying behavioural or clinical signs consistent with BSE	Cattle subjected to differential diagnosis; rabies suspect; downer cow due to unknown reason displaying over-reactivity (on farms)
Fallen stock	Cattle over 30 months of age which are found dead on the farm, during transport or at an abattoir	Cattle which die or become moribund on farms
Casualty slaughter	Cattle over 30 months of age that are non-ambulatory, recumbent, unable to rise or to walk without assistance; cattle over 30 months of age are sent for emergency slaughter or condemned at ante-mortem inspection (casualty, emergency slaughter or downer cattle)	Downer cattle
Routine slaughter	Cattle over 36 months of age at routine slaughter	Cattle which are eligible for human consumption

BSE: bovine spongiform encephalopathy
OIE: World Organisation for Animal Health

from 2006, the tests to be used. Before 2006, all testing was carried out by the NRL. Seventeen biosafety level (BSL) III laboratories were constructed in provincial animal health institutes to screen for BSE, using two commercial rapid test kits: the Bio-Rad TeSeE® and IDEXX HerdChek®. Raw test data were submitted to the NRL each month to enable the oversight of test and laboratory performance.

From 1996 to 2007, before the enhancement of the surveillance programme, the number of samples assigned to each city/province was in proportion to the size of the local adult cattle population and/or the slaughter output.

Specific actions taken during enhanced surveillance

From 15 May 2008, all non-ambulatory cattle arriving at an abattoir were compulsorily sampled and tested for BSE, and the carcasses were held, along with their by-products, until a negative result was obtained. Brain-stem samples were transported to the nearest BSL III laboratory to be screened for BSE.

In addition, members of the Mutual Aid Insurance Scheme were encouraged to submit all dead bovines that had been examined and recorded under the scheme for BSE testing. In addition, all clinical suspected cases identified on the farm by animal health investigators from the Livestock Health Control Association, and subsequently examined by veterinarians, were purchased at 50% of their market price and culled on the farm, while specified tissues, including the brain-stem, were submitted to the NRL. Financial incentives were offered to encourage the reporting and submission of clinical suspects. The brain-stem was tested for BSE by the NRL, while a differential diagnosis was conducted by the Animal Disease Diagnostic Division. The results of the differential diagnoses will be published elsewhere in detail.

The designation of sampled cattle as clinical suspects involved submitting a statutory form in which clinical signs were described, alongside photos, video clips or additional data about the suspect animal.

Results

From 1996 to 30 October 2009, all primary surveillance diagnostic test results were deemed to be negative. In January 2006, when provincial animal health institutes took over the responsibility for rapid testing from the NRL, and in accordance with NRL instructions, all initial reactives found in rapid testing were resolved without the need to submit further samples to the NRL for confirmation.

The conversion of raw test results into scores that vary according to surveillance stream is a key step in evaluating risk, according to the OIE guidelines. The scores that resulted from the Korean surveillance programme are summarised in Tables IV and V. While clinical suspects are the preferred target for surveillance, the outcome is compromised if there has been reluctance to report the suspicion of disease on a farm. The score of 31,690 points accumulated before 2003 resulted from only 107 clinical suspects. The desire to compensate for the lack of clinical suspects by testing cattle in the most easily accessible surveillance stream – healthy animals slaughtered for human consumption – generated a poor return, i.e. only 628.91 points over the same seven-year period (from 5,162 cattle tested) (Table IV).

Estimating the size of the casualty-slaughter population, which was easily detectable at abattoirs, offered scope for improving the value of surveillance testing, especially where these animals exhibited signs that were consistent with being classified as clinical suspects (Table III). Consequently, together with significant improvements in the reporting of clinical suspects on the farm, a total of

Table IV
The number of samples and World Organisation for Animal Health points from 1996 to 2002 in the Republic of Korea

Year	Clinical suspects		Casualty slaughter		Fallen stock		Routine slaughter		Total	
	Head	Points	Head	Points	Head	Points	Head	Points	Head	Points
1996	3	520	0	0	0	0	1,616	163.5	1,619	683.5
1997	2	520	15	12	0	0	308	36.81	325	568.81
1998	1	0	0	0	0	0	312	37.42	313	37.42
1999	1	0	0	0	0	0	301	35.72	302	35.72
2000	39	10,930	0	0	0	0	453	54.75	492	10,984.75
2001	14	4,865	4	6	0	0	1,076	144	1,094	5,015.52
2002	47	14,855	17	20	19	12.1	1,096	156.71	1,179	15,043.81
Total	**107**	**31,690**	**36**	**38**	**19**	**12**	**5,162**	**628.91**	**5,324**	**32,369.53**

402,250 points were accumulated in clinically affected animals over a seven-year period. The majority of points came from testing between 2007 and 2009 under the enhanced surveillance programme (Table V).

The top five provinces where the clinically suspect animals were found from 2003 to October 2009, were, in order of decreasing numbers of detected suspect animals:

– Gangwon-do Province
– Gyeonggi-do Province
– Gyeongsangbuk-do Province
– Gyeongsangnam-do Province
– Chungcheongnam-do Province (Table VI).

These were the areas with the largest adult cattle populations, with the exception of Gangwon-do, which

Table V
The number of samples and World Organisation for Animal Health points from 2003 to October 2009 in the Republic of Korea

Year	Clinical suspects (farm/abattoir)		Casualty slaughter		Fallen stock		Routine slaughter		Total	
	Head	Points	Head	Points	Head	Points	Head	Points	Head	Points
2003	12 (12/0)	5,355 (5,355/0)	4	5.2	0	0	1,022	155.8	1,038	5,516
2004	18 (18/0)	10,300 (10,300/0)	23	29.6	159	79.7	2,123	299.02	2,323	10,708.32
2005	16 (16/0)	4,550 (4,550/0)	585	748.3	94	47.1	3,459	506.72	4,154	5,852.12
2006	2 (2/0)	1,500 (1,500/0)	1,169	1,521.5	159	75	4,686	716.03	6,016	3,812.53
2007	91 (16/75)	45,945 (9,550/36,395)	3,277	3,829	236	82.4	4,764	730.59	8,368	50,586.99
2008	292 (160/132)	155,370 (84,835/70,535)	5,538	6,226	165	93.6	12,667	1,835.69	18,662	163,525.3
Up to and including October 2009	372 (365/7)	179,230 (175,940/3,290)	4,824	4,850.5	34	12.1	19,275	2,825.61	24,505	186,918.21
Total	**803 (589/214)**	**402,250 (292,030/110,220)**	**15,420**	**17,210.1**	**847**	**389.9**	**47,996**	**7,069.47**	**65,066**	**426,919.5**

Table VI
The number of clinical suspects, by age and by city/province, from 2003 to October 2009 in the Republic of Korea

Cities/provinces	Clinical suspects						Regional distribution of adult cattle (%)[(a)]
	2 years of age or younger	2 – 3	4 – 6	7 – 8	9 years of age or older	Total	
Seoul (Capital city)	0	13	4	1	0	18	0.01
Busan (city)	0	0	3	0	0	3	0.12
Daegu (city)	0	4	3	0	0	7	0.78
Incheon (city)	0	11	6	0	1	18	0.48
Gwangju (city)	0	4	1	0	0	5	0.21
Daejeon (city)	0	0	2	0	0	2	0.20
Ulsan (city)	0	7	6	0	1	14	1.10
Gyeonggi-do (province) *	0	51	67	9	2	129	14.73
Gangwon-do (province) *	2	89	69	5	2	167	7.23
Chungcheongbuk-do (province)	0	26	27	1	0	54	6.42
Chungcheongnam-do (province) *	0	24	46	3	0	73	12.84
Jeollabuk-do (province)	1	8	29	1	0	39	9.49
Jeollanam-do (province)	0	39	25	0	0	64	14.70
Gyeongsangbuk-do (province) *	2	44	42	2	1	91	18.00
Gyeongsangnam-do (province) *	0	20	65	3	2	90	12.39
Jeju-do (province)	0	18	9	1	1	29	1.31
Total	**5**	**358**	**404**	**26**	**10**	**803**	**100**

a) Based on population statistics for adult cattle (over 24 months of age) (2003 – 2008)
*The top five provinces referred to in the section entitled: 'Results'
Cities were considered as separate entities from provinces with respect to surveillance, even though they are included in provinces

is close to the border with North Korea and subject to intensive surveillance for rabies in adult cattle. Animals showing neurological signs were tested for both rabies and BSE.

The overall outcome was that a total score of 426,919 points was accumulated over seven years, ending in October 2009. These points were derived from 803 clinical suspects (402,250 points), 15,420 casualties (17,210 points), 847 fallen stock (390 points) and 47,996 healthy slaughter cattle (7,069 points). Annual data are presented in Table V.

Discussion

Bovine spongiform encephalopathy presents many challenges to the establishment of rigorous and transparent surveillance systems in all countries, as well as to the determination of BSE risk. Before surveillance programmes in the European Union (EU) were greatly expanded in 2001, estimating BSE risk required surveillance data on clinical suspects, as well as the gathering of a large amount of historical data about statutory controls and industrial practices (waste disposal arrangements, feeding practices, importation policies for cattle and bovine-derived products) (5). Where such information did not exist, or had not routinely been collected, it could not be gathered retrospectively.

The development of rapid tests and their use in targeted surveillance programmes (2, 3) greatly improved the ability to identify BSE cases and establish more robust estimates of the prevalence of infection. This development occurred at a time of high public and political concern about BSE, as the world began to recognise the risk associated with consuming tissues from infected animals (17). The result was the establishment of massive surveillance programmes that were based primarily on age, and which targeted healthy cattle as well as clinical suspects, fallen animals and casualties (6, 21). Such programmes satisfied public demand in countries where BSE had been detected, but were complex and expensive to deliver.

The data that came out of the EU surveillance enabled the development of a scientific model (BSurvE) to assist in the establishment and evaluation of surveillance programmes. In particular, this model took into account the differing likelihood of detecting BSE cases within various exit streams. As diagnosis was only possible after death (18), the routes by which cattle left their farm of origin became potential surveillance streams, each presenting distinct opportunities and challenges. Clinical suspects offered the greatest likelihood of detection, followed by casualty cattle, fallen animals and, finally, healthy cattle slaughtered for human consumption. As highlighted in the scientific evidence that underpins current surveillance programmes and the present scoring system, the likelihood of detection also varied with age, being highest in mature animals that were closer to the onset of clinical disease. The BSurvE model enabled a point score to be attributed to individual animals in accordance with the surveillance stream in which they were tested. Over a period of years, these accumulated points gave a valuable indication of the likely prevalence within the national herd.

Such a flexible approach inevitably presented difficulties in obtaining international agreement for its use in underpinning international trading standards. The outcome was the acceptance of a modified, one-size-fits-all model that is the current OIE standard. This standard recognises that compromises have been made, but ensures transparency, so that all countries appreciate what is required of them and of their trading partners. The OIE accepts that the points acquired remain valid only for a period of seven years, and it is the accumulated score over that length of time that is the target. Furthermore, different target prevalences were built into programmes for countries categorised as being of negligible or controlled risk. These targets recognise that the size of the programme should be proportionate to the risk, as agreed by third-party review.

It was in this context that the enhanced surveillance programme in the ROK was established in July 2008, with the aim of testing as many animals as possible within the high-risk populations. Two particular challenges were faced by the ROK. The first was the absence of any centralised mechanism for disposing of fallen stock from farms, which had assisted considerably when establishing surveillance for that particular exit stream in Europe (2, 3). This resulted in a disappointing deficit in the numbers of fallen stock sampled, despite the requirements for submitting cattle carcasses included in the Mutual Aid Insurance Scheme from 2004, and the assignment of specific targets for individual cities and/or provinces. Submission rates did improve, but the totals reported were still low, relative to the estimated population of adult fallen stock of 140,000. Although it is possible that this figure represented an overestimate of the target population, it is also known that farmer/industry resistance was a key issue in preventing the reporting of potential surveillance targets.

Secondly, the absence of historical requirements to identify cattle individually meant that determining the age of adult cattle at the time of sampling, since they had inevitably been born before the regulations were strengthened, could only be approximate. It involved a range of administrative approaches, including the inspection of documentation submitted by owners when cattle were sent to slaughter, and examining the animal's teeth to try to ensure that sampled animals were more than 30 months of age. On the farm, veterinarians relied on a combined approach of farmer interrogation, dentition checks and, where available, the examination of supporting documentation, such as purchase, artificial insemination or calving records. Documentation was normally available for approximately 50% of the cattle sampled. Herd sizes in the ROK are small, with the vast majority comprising fewer than 50 animals (range: 91.57% to 95.18% from 2003, up to and including September 2009) (11). It was thought, however, that, in the absence of documentary evidence, farmers' recollections of the ages of their animals were more likely to be accurate in such small herds.

With respect to casualty animals detected at abattoirs, the numbers tested during the enhanced surveillance programme (5,538 in 2008 and 4,824 for the first ten months of 2009) compare favourably with the average of 4,588 animals reported as having been killed each year between 2004 and 2006. Their categorisation as either clinical suspects or casualties took place retrospectively, based upon clinical evidence submitted to the NRL.

The OIE guidelines acknowledge that not all surveillance streams are accessible for sampling in all countries. Improving the capture of clinical suspects in the surveillance programme, supported by veterinary reports and photographic evidence, provides more confidence in the categorisation of animals that have been tested. This also avoids any suspicion of inappropriate distortion of the surveillance data to increase the accumulation of points. In addition, it enables the evaluation of raw data by a third party, such as the OIE. The data presented in Table V represent an adjustment in the categorisation of cattle, based upon advice from the OIE after its evaluation of the ROK dossier. Animals which would probably once have been considered as clinical suspects were now assigned to the emergency slaughter surveillance stream. This change resulted in a reduction in the overall points score of 110,220.

Fears that the rules adopted to identify clinical suspects would eventually skew the data used for risk assessment proved to be unfounded. While, in 2007, the number of clinical cases detected at abattoirs far exceeded those reported on the farm (75:16), in 2008 these figures increased in both categories (132:160), until, in 2009, the vast majority were being detected on the farm (7:365). This indicates increased responsiveness of the farming industry to the demands of the surveillance programme (Table V).

Given that the majority of cattle sampled were born before the introduction of legislative controls on identification, it became necessary to estimate their age at sampling by the methods described above. A summary of estimated ages for the individual sampling streams is provided in Table VII. While the four-to-six-year-old category was the largest, the number sampled in younger age groups was greater than would generally be desirable. However, the OIE points allocation system takes this into account, ensuring that the points allocated are appropriate to the age structure of the animals being sampled.

The choice of two commercial rapid tests for preliminary screening – the Bio-Rad TeSeE® and IDEXX HerdChek® – which had been approved for BSE screening by the EU in 2001 and 2005, respectively (8), ensured that both had already been shown to perform robustly in large-scale programmes. The Bio-Rad TeSeE® and IDEXX HerdChek® tests were evaluated as performing with sensitivities of 100 (confidence interval [CI]: 99) and 100 (CI: 98.5), and specificities of 100 (CI: 99.7) and 99.99 (CI: 99.95), respectively (8).

A lack of positive test results during surveillance could indicate that the surveillance programme is doing what was intended, or could cause uncertainty about the testing process itself. Thus, workers relied upon the internal controls provided by the manufacturers, as well as the regular submission of raw test data to the NRL, to allow third-party scrutiny. In addition, the receipt of BSE-positive test samples from the UK OIE Reference Laboratory enabled in-house validation of confirmatory methodology.

Table VII
The number of samples and World Organisation for Animal Health points, by estimated age, from 2003 to October 2009 in the Republic of Korea

Classification	Clinical suspects		Casualty slaughter		Fallen stock		Routine slaughter		Total	
	Head	Points	Head	Points	Head	Points	Head	Points	Head	Points
2 years of age or younger	5	0	243	96	67	12.8	317	3.17	632	111.97
2 – 3	358	93,080	5,448	2,179.2	431	86.1	22,906	2,290.6	29,143	97,635.9
4 – 6	404	303,000	9,094	14,550.4	310	279	23,222	4,644.4	33,030	322,473.8
7 – 8	26	5,720	515	360.5	27	10.8	1,313	131.3	1,881	6,222.6
9 years of age or older	10	450	120	24	12	1.2	238	0	380	475.2
Total	**803**	**402,250**	**15,420**	**17,210.1**	**847**	**389.9**	**47,996**	**7,069.47**	**65,066**	**426,919.5**

Conclusion

The South Korean experience highlights the difficulties of establishing surveillance for BSE in any country, but particularly so in one with a relatively small cattle population where indigenous BSE has not previously been confirmed. Such confirmation inevitably affects all financial and logistic challenges faced when establishing a surveillance programme.

Nevertheless, the eventual outcome confirmed the scope for a flexible approach to surveillance, which has been built into the current OIE guidelines, as well as promoting confidence in the BSurvE model, which allows deficiencies in one or more surveillance streams to be compensated for by enhancing testing elsewhere.

It was satisfying that the considerable effort required in completing the programme did result in the OIE's acceptance of the ROK's 'BSE controlled risk' status, following the submission of a second dossier that was supported by the acquisition of 426,919 surveillance points.

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Résumé

La République de Corée a commencé à exercer une surveillance de l'encéphalopathie spongiforme bovine (ESB) sur le territoire national en 1996. Les programmes de surveillance ont évolué dans le temps, parallèlement aux lignes directrices de l'Organisation mondiale de la santé animale (OIE) en la matière. L'encéphalopathie spongiforme bovine est devenue une maladie à déclaration obligatoire en 1997. À partir de juillet 2008, le programme de surveillance de l'ESB s'est intensifié afin de rendre plus efficace le dépistage réalisé dans les populations bovines considérées à haut risque. Parmi les mesures introduites figurait l'obligation de tester toute bête bovine incapable de se déplacer au moment de son arrivée à l'abattoir ; il était en outre recommandé de tester toute bête bovine examinée et enregistrée dans le cadre du dispositif d'assurances mutuelles couvrant le bétail trouvé mort. En outre, une recherche active des animaux suspectés d'infection clinique a été effectuée. Durant sept années consécutives à compter d'octobre 2009, la Corée a accumulé 426 919 points de surveillance. De ce fait, ce pays a présenté avec succès une demande de reconnaissance officielle par l'OIE de son statut en tant que pays présentant un « risque maîtrisé d'ESB », conformément au chapitre 11.5 du *Code sanitaire pour les animaux terrestres* de l'OIE.

Mots-clés

Corée, République de – Encéphalopathie spongiforme bovine (ESB) – Organisation mondiale de la santé animale (OIE) – République de Corée – Surveillance.

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Vigilancia de la encefalopatía espongiforme bovina en la República de Corea

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Resumen

En 1996 se puso en marcha la vigilancia a escala nacional de la encefalopatía espongiforme bovina (EEB) en la República de Corea. Con el tiempo se fueron ajustando los programas de vigilancia para que cumplieran las directrices de la Organización Mundial de Sanidad Animal (OIE). La encefalopatía espongiforme bovina fue declarada enfermedad de notificación obligatoria en 1997. A partir de julio de 2008 se intensificó el programa de vigilancia con el fin de practicar más eficazmente pruebas de detección en los animales de las poblaciones bovinas consideradas de alto riesgo. Entre las nuevas medidas figuraban la de someter obligatoriamente a prueba a los animales que no pudieran caminar en los mataderos y la de fomentar igualmente la práctica de pruebas en todos los bovinos muertos examinados y registrados en el marco del sistema de seguro de ayuda mutua (ganado muerto). Además, se llevó a cabo una activa búsqueda de todo animal sospechoso de estar clínicamente infectado. Todo ello deparó un total de 426.919 puntos de la OIE en un lapso de siete años consecutivos, hasta finales de octubre de 2009, tras lo cual se solicitó y logró en 2010 que la OIE declarara a la República de Corea país "de riesgo controlado" de EEB, conforme al Artículo 11.5 del *Código Sanitario para los Animales Terrestres* de la OIE.

Palabras clave

Corea, República de – Encefalopatía espongiforme bovina (EEB) – Organización Mundial de Sanidad Animal (OIE) – República de Corea – Vigilancia.

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References

1. Baron T.G.M., Madec J.-Y. & Calavas D. (1999). – Similar signature of the prion protein in natural sheep scrapie and bovine spongiform encephalopathy-linked diseases. *J. clin. Microbiol.*, **37** (11), 3701–3704.

2. Doherr M.G., Heim D., Fatzer R. & Cohen C.H. (2001). – Targeted screening of high-risk cattle populations for BSE to augment mandatory reporting of clinical suspects. *Prev. vet. Med.*, **51**, 3–16.

3. Doherr M.G., Oesch B., Moser M., Vandevelde M. & Heim D. (1999). – Targeted surveillance for bovine spongiform encephalopathy. *Vet. Rec.*, **145**, 672.

4. Eloit M., Adjou K., Coulpier M., Fontaine J.J., Hamel R., Lilin T., Messiaen S., Andreoletti O., Baron T., Bencsik A., Biacabe A.G., Beringue V., Laude H., Le Dur A., Vilotte J.L., Comoy E., Deslys J.P., Grassi J., Simon S., Lantier F. & Sarradin P. (2005). – BSE agent signatures in a goat. *Vet. Rec.*, **156** (16), 523–524.

5. European Commission (EC) (2000). – Final Opinion of the Scientific Steering Committee on the geographical risk of bovine spongiform encephalopathy (GBR). Available at: ec.europa.eu/food/fs/sc/ssc/out113_en.pdf (accessed on 24 October 2010).

6. European Commission (EC) (2008). – Report on the monitoring and testing of ruminants for the presence of transmissible spongiform encephalopathy (TSE) in the EU in 2007. Available at: ec.europa.eu/food/food/biosafety/bse/annual_report_tse2007_en.pdf (accessed on 24 October 2010).

7. European Food Safety Authority (EFSA) (2005). – Opinion of the Scientific Panel on biological hazards (BIOHAZ) on: a qualitative assessment of risk posed to humans by tissues of small ruminants in case BSE is present in these animal populations. *EFSA J.*, **227**, 1–11.

8. Gavier-Widén D., Stack M.J., Baron T., Balachandran A. & Simmons M. (2005). – Diagnosis of transmissible spongiform encephalopathies in animals: a review. *J. vet. diagn. Invest.*, **17**, 509–527.

9. Kim T.Y., Kim Y.S., Kim J.K., Shon H.J., Lee Y.H., Kang C.B., Park J.S., Kang K.S. & Lee Y.S. (2005). – Risk analysis of bovine spongiform encephalopathy in Korea. *J. vet. med. Sci.*, **67** (8), 743–752.

10. Korean Agro-Fisheries Trade Corporation Statistics (2008). – Domestically produced beef consumption statistics. Available at: www.kamis.co.kr/customer/main/main.do (accessed on 16 March 2012).

11. Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF) [Republic of Korea] (2009). – Slaughtering statistics. Available at: www.qia.go.kr/livestock/clean/listTcsjWebAction.do?clear=1 (accessed on 16 March 2012).

12. Ozawa Y. (2003). – Risk management of transmissible spongiform encephalopathies in Asia. *In* Risk analysis of prion diseases in animals (C.I. Lasmézas & D.B. Adams, eds). *Rev. sci. tech. Off. int. Epiz.*, **22** (1), 237–249.

13. Prattley D.J., Morris R.S., Cannon R.M., Wilesmith J.W. & Stevenson M.A. (2007). – A model (BSurvE) for evaluating national surveillance programs for bovine spongiform encephalopathy. *Prev. vet. Med.*, **81** (4), 225–235. E-pub.: 22 May 2007.

14. Prince M.J., Bailey J.A., Barrowman P.R., Bishop K.J., Campbell G.R. & Wood J.M. (2003). – Bovine spongiform encephalopathy. *In* Risk analysis of prion diseases in animals (C.I. Lasmézas & D.B. Adams, eds). *Rev. sci. tech. Off. int. Epiz.*, **22** (1), 37–60.

15. Veterinary Laboratories Agency (VLA) (2007). – Clinical signs of bovine spongiform encephalopathy in cattle. VLA, Weybridge, Surrey. Available at: www.defra.gov.uk/vla/science/docs/sci_bse_res.pdf (accessed on 16 March 2012).

16. Wells G.A., Scott A.C., Johnson C.T., Gunning R.F., Hancock R.D., Jeffrey M., Dawson M. & Bradley R. (1987). – A novel progressive spongiform encephalopathy in cattle. *Vet. Rec.*, **121** (18), 419–420.

17. Will R.G., Ironside J.-W., Zeidler M., Cousens S.N., Estibeiro K., Alperovitch A., Poser S., Pocchiari M., Hofman A. & Smith P.G. (1996). – A new variant of Creutzfeldt-Jakob disease in the UK. *Lancet*, **347** (9006), 621–925.

18. World Organisation for Animal Health (OIE) (2011). – Chapter 2.4.6. Bovine spongiform encephalopathy. *In* Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. OIE, Paris. Available at: www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.04.06_BSE.pdf (accessed on 16 March 2012).

19. World Organisation for Animal Health (OIE) (2011). – Chapter 11.5. Bovine spongiform encephalopathy. *In* Terrestrial Animal Health Code. OIE, Paris. Available at: www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2010/chapitre_1.11.5.pdf (accessed on 16 March 2012).

20. World Organisation for Animal Health (OIE) (2012). – Bovine spongiform encephalopathy. Geographical distribution of countries that reported BSE confirmed cases since 1989. Available at: www.oie.int/animal-health-in-the-world/bse-specific-data/map/ (accessed on 16 March 2012).

21. Yamanouchi K. & Yoshikawa Y. (2007). – Bovine spongiform encephalopathy (BSE) safety measures in Japan. *J. vet. med. Sci.*, **69** (1), 1–6.