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Control of an outbreak of highly pathogenic avian influenza, caused by the virus sub-type H5N1, in Japan in 2004

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Summary
An outbreak of highly pathogenic avian influenza (HPAI), caused by the virus sub-type H5N1, occurred at four premises in three prefectures in Japan during January and March 2004. As a result, 274,654 poultry died or were slaughtered. This was the first outbreak of HPAI in Japan since 1925. (The earlier outbreak was caused by H7N7.) The disease was successfully eradicated within three-and-a-half months, following an eradication campaign that included depopulating the affected premises, implementing movement controls and intensive surveillance. Control measures were conducted in accordance with the National *Manual of HPAI Control*. However, during the eradication campaign, some key issues arose, such as delays in notification by the affected farmers. As a result of these experiences, the relevant laws and *HPAI Control Manual* have been appropriately revised.

Keywords
Avian influenza – Control measures – Disease control – Eradication – H5N1 – Highly pathogenic avian influenza – Japan – Manual – Poultry – Prevention – South-east Asia – Surveillance.

Introduction

During the last few years, highly pathogenic avian influenza (HPAI) outbreaks have been reported in South America, South-east Asia and Europe (16). Among these outbreaks, those caused by the H5N1 sub-type have been reported in nine Asian regions since December 2003, and continue to occur in South-east Asia at the time of writing (December 2004) (Fig. 1) (1, 15). More than forty human cases, including fatalities, have been associated with this virus sub-type (20). Such a series of outbreaks, occurring simultaneously in many countries, is extremely unusual.

The HPAI outbreak in Japan was confirmed in January 2004, and followed outbreaks in the Republic of Korea and Vietnam. This was the first outbreak of HPAI in Japan since 1925, and involved four premises in three prefectures. (The 1925 outbreak was caused by H7N7.) During the most recent outbreak, a total of 274,654 poultry died or were destroyed. In this paper, the authors describe the

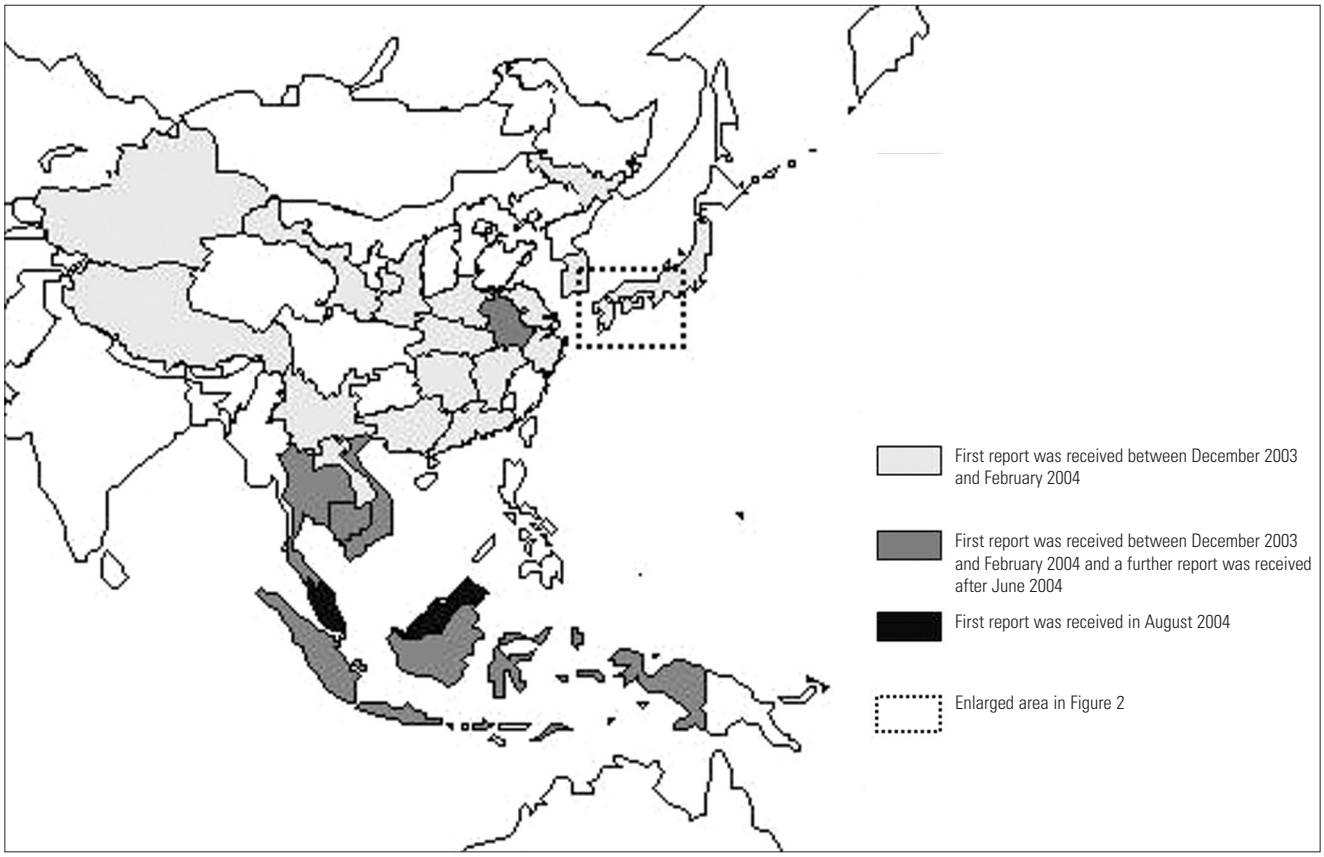

Fig. 1
Countries and regions of Japan and the People's Republic of China which have officially reported outbreaks of highly pathogenic avian influenza, virus sub-type H5N1
Source: Food and Agriculture Organization Avian Influenza Disease Emergency news (1); OIE *Disease information* (15)

possible sources of introduction of the HPAI virus, its epidemiology and various eradication strategies. The authors also discuss key issues which arose during the eradication to aid in ensuring future preparedness.

Outbreaks of highly pathogenic avian influenza

The first case of HPAI in Japan was confirmed in Yamaguchi prefecture in January 2004, and the disease was detected in two other prefectures, Oita and Kyoto, in February. The affected farms were generally located in villages surrounded by mountains. However, these farms were at some distance from one another (Fig. 2), and conducted different types of operations (Table I).

Infected site 1

On 28 December 2003, the owner of 34,640 layer chickens noticed the sudden deaths of eight chickens raised in one of six sheds, which housed approximately 6,000 chickens each. On the following day, a report of suspected disease was received by the Livestock Hygiene Service Centre (LHSC), a prefectural centre for animal health issues, from a private veterinarian. The infected poultry exhibited lethargy and died suddenly, without showing any other signs typical of HPAI, such as a drastic decline in egg production or facial oedema. Although control measures were implemented, including disinfection and containment, the number of dead chickens continued to increase. By the eighth day after the report, more than 100 poultry per day had died in the index shed (Fig. 3), and poultry in the other sheds also began to die. Virus isolation tests (by inoculating tracheal and cloacal swab samples into the allantoic cavities of embryonated chicken eggs) confirmed the presence of the H5 sub-type of HPAI virus on 12 January 2004 and control measures against HPAI were initiated on that day. By that time, large numbers of dead poultry were observed in five of the six sheds. The N1 sub-type was subsequently confirmed.

Infected site 2

The sudden deaths of three bantams were reported on 14 February 2004, by the owner of a hobby flock of 13 bantams and one duck (*Anas platyrhynchos domestica*) in

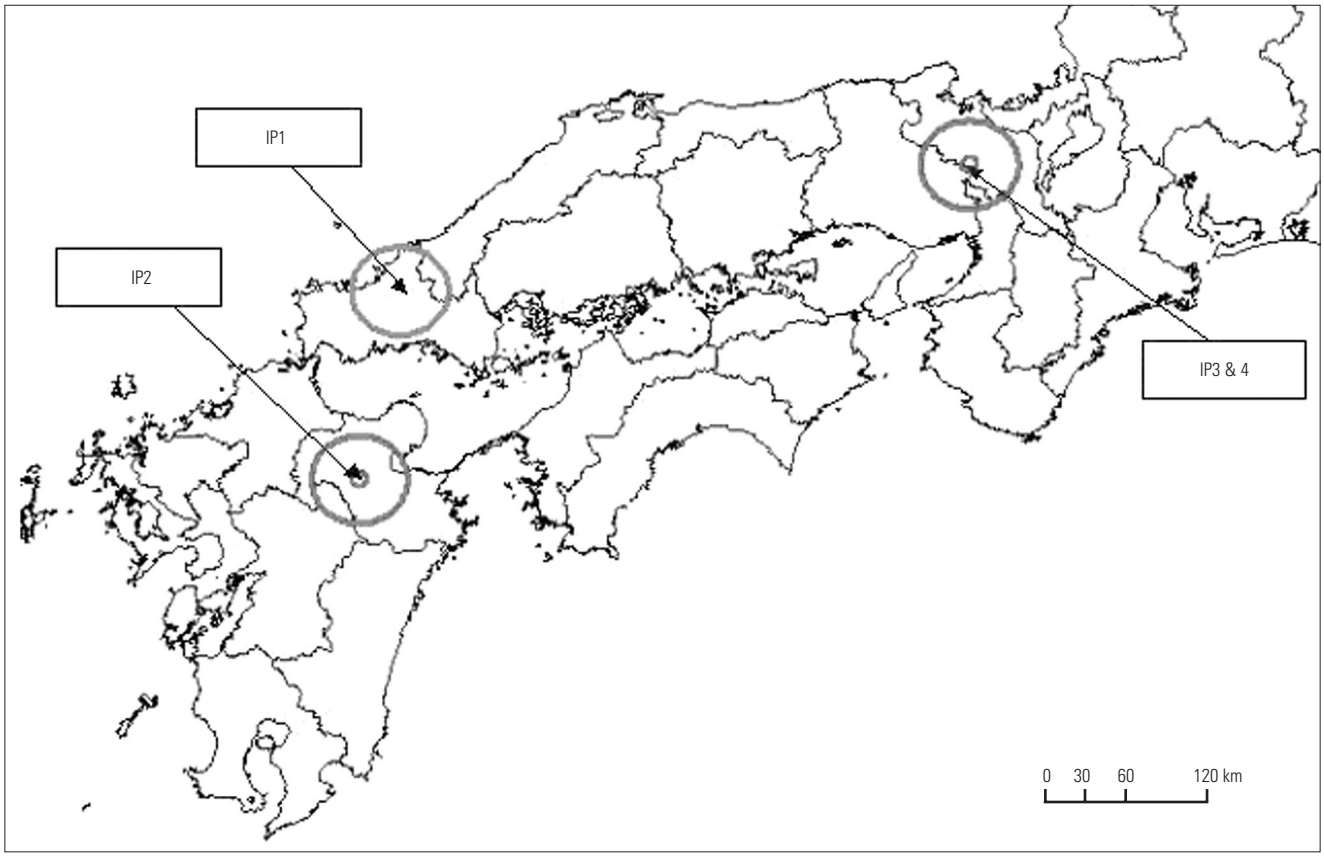

Fig. 2
Location of outbreaks and movement control areas during an outbreak of highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004
Large circle: 30-km radius around infected premises (IP)
Small circle: 5-km radius around IP
Movement control areas were established within a 30-km radius of the IP as a primary prevention measure. These zones were later scaled down to a 5-km radius, while the outer area of the former movement restriction zone became a surveillance zone. At IP1, the movement restriction zone remained unchanged throughout the response to the outbreak

Table I
Description of premises infected with highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004 and measures taken

IP	Location (prefecture)	Susceptible birds	Production type	Type of housing	Number of birds culled	Date of clinical onset of disease	Date of report to LHSC	Date of confirmation	Completion of containment	Movement controls (MC) applied		
										MC confirmation (30 km)	MC (5 km) and surveillance zone (5-30 km)	Completion of surveillance
1	Yamaguchi	Chickens	Layers	Caged in a shed	34,640	28 Dec.	29 Dec.	12 Jan.	21 Jan.	12 Jan.-19 Feb.	Not applied	14 Feb.
2	Oita	Chickens and 1 duck	Hobby flock	Caged in the back yard	14	14 Feb.	14 Feb.	17 Feb.	18 Feb.	17-28 Feb.	28 Feb.-11 March	3 March
3	Kyoto	Chickens	Layers	Caged in a shed	225,000	17 Feb.	26 Feb.	29 Feb.	22 March	29 Feb.-1 April	1-13 April	10 April
4	Kyoto	Chickens	Broilers	Free range in a shed	15,000	3 March	3 March	5 March	11 March			

IP: infected premises
LHSC: Livestock Hygiene Service Centre

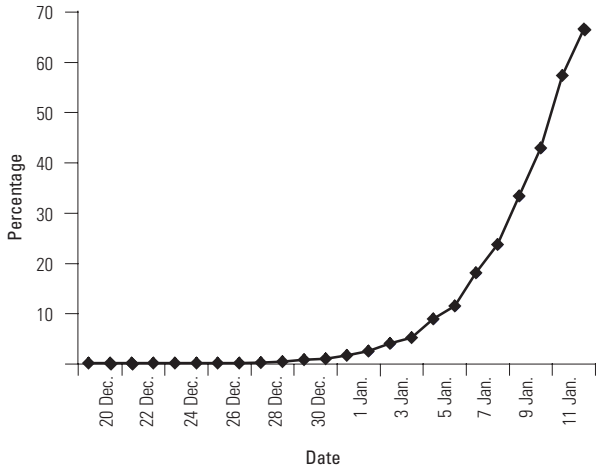

Fig. 3
The cumulative mortality of an index flock at infected premises 1, during an outbreak of highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004

Oita prefecture. Four more bantams raised in the same shed died two days later. The remainder of the six chickens, raised in two sheds nearby, and a free-range duck did not show any clinical signs of the disease. For preventive purposes, all the poultry were destroyed with the consent of the owner. The presence of sub-type H5N1 of the avian influenza (AI) virus was confirmed on 17 February.

Infected sites 3 and 4

The third case of HPAI was confirmed on 29 February in a layer farm in Kyoto prefecture, with 225,000 chickens in ten sheds. Although the owner had noticed an abnormal number of deaths since mid-February (specifically, over 100 deaths per day in a shed with 30,000 chickens), he had not reported it to the LHSC. The first report was made anonymously on 26 February. When prefectural veterinary officers visited the farm, large numbers of deaths were observed in all ten sheds. The presence of H5 influenza virus was confirmed on 29 February and the N1 sub-type was later confirmed. An investigation revealed that approximately 15,000 chickens had been shipped from other sheds on the farm to two slaughterhouses. The H5N1 sub-type virus was subsequently recovered from chickens traced from one of the slaughterhouses. The infection was also confirmed in other flocks of chickens which had spent one night in the slaughterhouse with the affected flock.

On 3 March 2004, the owner of a broiler farm, located approximately 4 km from infected premises (IP) 3, reported the sudden deaths of 11 chickens in one of five sheds housing approximately 3,000 chickens each. After the recent outbreak of HPAI, this owner had introduced preventive measures, such as decontaminating the site, and vehicles and people entering the site, and limiting the number of entrants to the premises. As HPAI was suspected, due to the increasing number of sudden deaths and the fact that this farm was in proximity to IP3, all 15,000 chickens were slaughtered on 4 March, before laboratory confirmation. The presence of sub-type H5N1 AI virus was subsequently confirmed on 5 March.

Clinical signs and pathological findings

Most birds died after exhibiting depression and lethargy, or were found dead before any clinical signs had been observed. Some chickens had gizzards filled with undigested feed, which suggested the sudden deaths occurred before anorexia. Clinical signs and gross lesions were observed in some individuals, such as the following:

– swelling of the eyelids and subcutaneous tissues of the cervix

– slight cyanoses in dead bantams

– haemorrhagic or green diarrhoea

– dilation and hyperaemia of the cloaca and caecum in both layers and broilers

– paralysis in the legs and/or wings of some layers.

On two layer farms, the decline in egg production was not significant, but the number of soft shells and broken eggs slightly increased. Some layers showed haemorrhage and/or autolysis of the ovaries, while other layers held the eggs with their shells in the oviduct, suggesting sudden death without depression of egg laying.

In histopathological studies, petechial haemorrhages in the ovaries and oviduct, degeneration and necrosis in the liver and spleen, and necrosis accompanying the proliferation of neuroglial cells in the cerebrum were observed in some individuals. Viral antigen was detected not only in the internal organs mentioned above, but also in the heart, kidney, gizzard and proventriclus, by immuno-histochemical staining (5, 14).

Characterising the isolated viruses

The viruses isolated from the four IP were all identified as sub-type H5N1 and classified as HPAI virus by the intravenous pathogenicity index (IVPI) test (17). All eight chickens tested had died within the same 24-hour period (9).

The nucleotide sequences of all eight HPAI viral segments were compared against strains isolated from other chickens from the three outbreak sites, as well as from dead crows found near IP3.

More than 99% similarity was observed among all eight segments of the Japanese isolates (3). One of these strains, named A/chicken/Yamaguchi/7/2004, was then compared to other H5N1 strains isolated in the People's Republic of China, Hong Kong, Korea and Thailand during outbreaks from 2003 to 2004. Comparing the nucleotide sequences demonstrated that the Japanese strain had more than 99% similarity with the strain isolated in Korea in December 2003 in all eight segments (Table II). Interestingly, phylogenetic analysis of the H5N1 strains recently isolated in Asia showed that the strains isolated in Thailand and Vietnam belonged to a different genetic group from those isolated in Korea and Japan (8).

Transmission experiments

Experimental inoculations were performed in white leghorn chickens, Japanese quail (*Coturnix japonica*), budgerigars (*Melopsittacus undulates*), large-billed crows (*Corvus macrorhynchos*), Cherry Valley ducks (*A. platyrhynchos*), BALB/c mice and miniature pigs. All inoculated chickens, quail and budgerigars died. Indeed, budgerigars died after showing serious neurological disorders. The H5N1 virus was recovered from multiple internal organs of all the species above (4). In crows, the virus was recovered from tracheal/cloacal samples, but all the crows survived and developed virus-specific serum antibodies, although some showed slight clinical signs such as facial oedema (3). None of the inoculated ducks showed clinical signs during 14 days of observation, but the virus was recovered from the multiple internal organs of two which were euthanased on day 3 post inoculation (p.i.). These organs also showed histopathological lesions. On day 14 p.i., H5N1 was not recovered from the remaining ducks and virus-specific serum antibodies were detected (6).

In mammals, mice that were internasally infected with 10^6 embryo infective $dose_{50}$ (i.e. the dose needed to infect 50% of inoculated embryos) died and the H5N1 virus was recovered from the lungs and brain (7). However, all inoculated miniature pigs remained alive. The virus was not recovered from any nasal swabs and virus-specific serum antibodies were not detected on day 14 p.i. (4).

Response and control measures

System for diagnosis

There are a total of 178 LHSCs in the 47 prefectures. These centres undertake animal disease control under the local prefectural government administration. When the LHSC receives a report of a suspected outbreak, prefectural veterinary officers are sent to the premises immediately. The officers clinically inspect the animals, gather epidemiological information and collect appropriate samples for diagnosis. When HPAI is suspected, based on the mortality rate or other clinical signs, tracheal/cloacal swabs, sera and internal organs are taken for diagnosis. Virus isolation tests are performed by inoculation into chicken eggs in prefecture laboratories. When type A influenza virus is suspected, the samples are sent to the National Institute of Animal Health (NIAH) for further confirmation. The NIAH conducts haemagglutination inhibition and neuraminidase inhibition tests to confirm the H and N sub-types, as well as IVPI tests. In Japan, eradication campaigns are begun for any outbreaks caused by the H5/H7 sub-types of influenza A virus, regardless of pathogenicity.

Control measures and surveillance

All control measures are based on the Domestic Animal Infectious Diseases Control Act, 1951 (11), and specific measures are prescribed in the national *Manual of HPAI Control* (10). When an HPAI outbreak is confirmed, HPAI management units are established at the Ministry of Agriculture, Forestry and Fisheries (MAFF) and prefectural

Table II
Sequence comparison between A/chicken/Yamaguchi/7/2004 and other recent H5N1 influenza viruses in South-east Asia

DNA segment	Percentage of segment nucleotide homology with A/chicken/Yamaguchi/7/2004			
	A/chicken/ Korea/ES/2003	A/chicken/ Shantou/4231/2003	A/goose/ Thailand/79/2004	A/HongKong/ 212/2003
PB2	99.7%	99.2%	98.9%	98.9%
PB1	99.8%	99.3%	98.5%	99.1%
PA	99.7%	99.6%	93.6%	93.8%
HA	99.5%	98.5%	97.2%	97.3%
NP	99.7%	99.5%	98.7%	99.1%
NA	99.6%	98.8%	97.3%	89.8%
M	99.9%	99.4%	98.8%	98.9%
NS	99.4%	99.3%	98.2%	98.5%

government. At the outbreak sites, LHSCs are responsible for the eradication campaign, including the following measures:

– depopulation of all poultry at the IP
– establishment of movement controls around the IP
– intensive surveillance.

Table I summarises the control measures taken and their duration.

Depopulation of infected farms and containment

All poultry on the infected farms were killed in a humane manner, using carbon dioxide. Contaminants, such as carcasses, eggs, manure and feed, were disinfected then buried or incinerated within or near the premises. In particular, at IP3, which had over 200,000 chickens, carcasses were buried on an adjacent site and the faeces were disposed of by composting. That is, after disinfection, the chicken excrement was gathered and hydrated lime was piled on top in a layer 15 cm thick. The faeces were sealed up in double nylon sheets, and the surfaces of the sheets were disinfected. Virus isolation tests of samples taken from the compost four weeks and eight weeks after completion of this measure gave negative results.

Extra human resources, i.e. members of the Self Defence Forces (SDF), were used to help in the containment work. It was the first time that the SDF had participated in the animal health response system in this way. With the co-operation of the SDF, some 225,000 caged chickens were slaughtered and related contaminants were disposed of within 23 days.

Movement controls and surveillance

Immediately after the confirmation of HPAI, movement control areas were established. First, a movement control area was implemented within a 30-km radius of the IP in Yamaguchi, Oita and Kyoto. Any transportation of live poultry, poultry products and/or any commodities that might potentially spread the virus was prohibited outside this zone.

Disinfection points were established on the main roads near the boundary of this area for the vehicles of poultry-related industries. When no additional cases were detected in the movement control areas of the Oita and Kyoto prefectures, these zones were decreased or 'scaled down' to a 5-km radius of the IP. The outer area of the former movement control zone (between 5 and 30 km) became a surveillance zone. Transportation of any potential contaminants out of the 5-km zone was prohibited. These movement control areas were maintained for at least 21 days after the completion of containment operations at the IP, and until surveillance confirmed that the area was free from disease. The locations of the movement control areas and the numbers and descriptions of the poultry farms within those areas are shown in Figure 2 and Table III, respectively.

Surveillance measures consisted of the following:

– clinical inspection
– serological testing
– virus isolation testing.

These measures were targeted at all commercial poultry farms and selected smallholdings within the movement control areas. When selecting smallholdings for testing, the following factors were given priority:

– whether poultry were kept outside
– whether several species were being raised together
– whether the site included a body of water that attracted wild birds.

Prefectural veterinary officers collected samples according to the regime in Table IV. Table V shows the numbers of samples collected. No premises tested positive for the presence of HPAI within the movement control areas and surveillance zones. Even after the movement control measures were lifted, all commercial poultry farms within a 30-km radius were monitored for at least three months. Clinical inspection, serological testing and virus isolation testing were conducted at least once during the monitoring period.

Investigation of wild birds

An investigation of wild birds, including migratory waterfowl, was conducted within a 10-km radius of the three IP between February and March. Samples of faeces and tracheal/cloacal swabs were collected from 312 waterfowl and 264 crows for virus isolation testing. Samples were also gathered from 292 wild terrestrial birds

Table III
Description of poultry farms[a] located within a 30-km radius of infected premises during an outbreak of highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004

Areas within radius of:	Number of farms		Number of poultry raised	
	Chicken	Other	Chickens	Other birds
IP1	20	0	1,294,000	0
IP2	65	3	1,294,000	53,200
IP3 and 4	79	2	1,390,330	21,000

a) Farms with more than 1,000 birds
IP: infected premises

Table IV
Sampling regime for poultry surveillance within a 30-km radius of infected premises during an outbreak of highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004

Type of farm	Farms to be sampled	Number of sheds to be sampled per farm		
		Number of sheds	Number of sheds to be sampled	Number of poultry to be sampled per shed
Commercial poultry farms	All	1	1	10
with more than 1,000 birds		2-9	More than half	5
		10 and over	More than two thirds	5
Smallholdings or hobby flocks	More than 100	–	–	5

Table V
Number of poultry tested and results of surveillance conducted within a 30-km radius of infected premises during an outbreak of highly pathogenic avian influenza, virus sub-type H5N1, in Japan in 2004

Surveillance areas within 30-km radius:	Number of rounds of testing	Number of farms tested			Number of poultry tested		Results
		Farms with more than 1,000 poultry	Small -holdings	Total	Serological test	Virus isolation test	
IP1	1st only	20	52	**72**	1,416	1,450	Negative
IP2	1st	68	187	**255**	1,915	1,464	Negative
	2nd	68	104	**172**	1,515	1,235	Negative
IP3	1st	81	254	**335**	2,056	2,055	Negative
	2nd	81	260	**341**	2,077	2,062	Negative

IP: infected premises

for serological and virus isolation testing. In total, 33 species of birds were tested, belonging to 15 families, namely:

– Anatidae
– Corvidae
– Scolopacidae
– Pycnonotidae
– Laniidae
– Turdidae
– Sylviidae
– Aegithalidae
– Paridae
– Emberizidae
– Fringillidae and others.

The H5N1 virus was isolated from nine dead or moribund large-billed crows (*Corvus macrorhynchos*), collected within a 30-km radius of IP3 between early March and early April (3). However, an epidemiological incident had been observed in which crows were seen gathering round the open-air compost of IP3, where dead chicken carcasses had been buried before disease control measures were implemented by the LHSCs. Thus, it was suspected that these crows might have been infected through contact with the carcasses. After the infected crows were detected, an extensive and nationwide examination of crows and wild birds was conducted. A total of 392 trapped or dead crows and 5,503 wild birds were tested throughout Japan for virus isolation and/or antibody detection, but no positive cases were identified.

Compensation

In all, 274,654 poultry died or were destroyed at the four IP. The government paid 80% of the estimated commercial value of the poultry and 50% of the cost of contaminant disposal at the IP as compensation to the farmer, in accordance with the Domestic Animal Infectious Diseases Control Act. The government also paid 50% of the lost revenues from and/or storage costs for eggs, which could not be shipped from layer farms during the movement control periods. Legislation was introduced after the outbreak to establish these compensation schemes.

Vaccination

In Japan, vaccination is not the first choice for controlling HPAI. However, when the prompt destruction of birds becomes difficult due to continuous outbreaks, strategic

vaccination may be performed with the permission of the prefecture governor, following consultation with MAFF.

A total of 320 million doses of inactivated vaccine (H5N2) were immediately imported during this outbreak, in case of emergency, but their use did not prove necessary.

Restocking

After an IP had been disinfected at least three times, at one-week intervals, virus isolation tests were conducted on the sheds, while sentinel chickens underwent a combination of clinical, serological and virus isolation tests. When such test results for IP4 were confirmed as being negative, IP4 reopened for farming in August 2004.

Human health issues

Workers on the affected farms, their families and all those who had been in contact with the infected poultry, including the containment workers on site, were examined, monitored and prescribed Oseltamivir prophylactically, under the guidance of the Ministry of Health, Labour and Welfare (MHLW).

Although there were no reports of any influenza-like cases during the response to the outbreak, serological tests were performed by the MHLW, using the Kyoto strain, to investigate the seroprevalence of non-clinical cases of the H5N1 sub-type. The MHLW officially reported the detection of antibodies against the Kyoto strain in human sera derived from five people by neutralisation assay. One farm worker at IP3, who exhibited seroconversion, had a sore throat for several days after participating in the disposal operations. However, this person did not develop fever or any other systemic symptoms. The remaining four people (three farm workers at IP3 and one prefectural veterinary officer who took part in the initial investigation of IP3) did not develop any systemic flu-like symptoms, such as fever (13).

Sources of introduction and route of spread

Epidemiological investigations were conducted on the affected farms to discover the source of the introduction of the virus into the flocks. The 77 people who had worked on or visited the affected premises and the 221 movements, in total, of animals, vehicles and equipment during the four weeks prior to the outbreaks, were all investigated. Possible transmissions of the virus between farms and the introduction of the disease agent from overseas were also considered. In addition, the farms or facilities associated with these animal, vehicle and equipment movements were also thoroughly examined. However, after extensive investigation, there was no evidence to indicate that the virus had been introduced through the domestic or international movement/transportation of people, animals, vehicles or any other commodities.

Furthermore, surveillance provided no evidence that the low pathogenic strain had been introduced and was circulating in the environment before the outbreak and had then mutated into a highly pathogenic strain. Thus, it was naturally concluded that the virus was probably introduced from overseas through indirect contact.

There are several reports of the introduction of AI virus through poultry meat or its products (7, 19). In Japan, H5N1 virus with high pathogenicity was isolated from duck breast meat imported from Shandong Province, the People's Republic of China, in May 2003. The virus was discovered during the quarantine examination before clearance. Thus, there is a possibility that the virus was introduced into poultry flocks in Japan through imported poultry products.

On the same day as Korea reported an outbreak of H5N1, MAFF suspended the importation of Korean poultry and poultry products. However, approximately 30,000 tonnes of poultry meat, viscera and associated products were imported from the People's Republic of China for about five months, from August 2003 to January 2004, until outbreaks of H5N1 infection were reported there. Thus, it is possible that the virus was introduced through uncooked or insufficiently cooked swill, derived from imported poultry products from the People's Republic of China. However, the farms affected by the outbreak were localised in western Japan, whereas the imported meat and products were distributed evenly throughout the country. Furthermore, the outbreaks occurred in mountain areas, away from the cities where more swill would be expected to be used. Finally, no evidence of infection was found in carnivorous birds, such as crows, before the outbreaks in poultry. Considering these points, the possibility that the virus was introduced through swill derived from poultry products imported from the People's Republic of China is considered small.

It is known that, from late October, southerly migratory birds, including waterfowl such as mallards (*A. platyrhynchos*), migrate from the north-east of the People's Republic of China to Japan, either directly or by way of the Korean peninsula, to spend the winter. Although the southerly migration is generally complete by early December, the shortest distance between the outbreak sites

in Japan and those in Korea is 400 km. Mallards can easily fly this distance. In Korea, the H5N1 outbreaks continued sporadically from mid-December to late March. When the Yamaguchi strain was experimentally inoculated into ducks, it was shown that the virus could be recovered from multiple internal organs without the animals showing any clinical signs of disease (6). Thus, it is possible that mallards infected elsewhere might be able to carry the virus into Japan, travelling the short distance between the two countries. Also, when the nucleotide sequences of the H5N1 strains recently isolated from Asian countries were compared, it was the Korean strain which showed the highest percentage of similarity to the Japanese isolate. Moreover, the Japanese outbreaks occurred in quiet mountain areas where various species of migratory birds are observed and conditions are known to be suitable for them. Although the H5N1 virus was not recovered from migratory birds during surveillance in either Korea or Japan, and there is no direct evidence to support this hypothesis, it seems likely that the virus was introduced through infected migratory birds, such as mallards, flying to Japan from the Korean peninsula.

Discussion and conclusions

Keys to successful early eradication

Japan succeeded in limiting the H5N1 outbreaks to four premises in three regions, and eradicated them within three-and-a-half months. The keys to managing this were considered to be:

– effective containment measures

– the slaughter of all poultry at the IP

– the implementation of movement controls around the affected zone.

Although one IP had more than 200,000 chickens, human resources, including the use of the SDF, were well co-ordinated from an early stage. This resulted in successful containment within 23 days, a relatively short period of time.

Secondly, epidemiological tracing work was conducted promptly to prevent the spread of the disease. The slaughterhouses that received infected chickens from IP3 were immediately identified and the appropriate measures were then rapidly implemented.

Thirdly, awareness by farmers of this disease was much improved during the eradication campaign. This led many farmers to take their own protection measures, such as disinfection, and prevented the spread of disease. In addition, such heightened awareness encouraged early reports from owners, as observed at IP2 and IP4.

Finally, the fact that no breeding farms or hatcheries were involved in the outbreaks may have contributed to minimising the spread of the disease.

Issues raised during the emergency response and revisions to the law and *Manual*

Although the measures taken during the eradication campaign were in accord with the recommendations of the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization (FAO) of the United Nations, and basic disease prevention and control strategies were already in place, some issues of concern arose.

The delay in reporting could have resulted in the spread of the disease. In particular, delays in reporting by large poultry farms may cause serious problems, as they are potential major sources of disease spread. Therefore, penalties have been strengthened against owners who intentionally conceal suspected cases. In addition, for owners who wish to reopen farms, a mutual aid fund has been established, with financial support from the government, to compensate these farmers for any expenses not already covered in law (11).

Since, during the early stages of the eradication campaign, movement controls were uniformly applied within a radius of 30 km of the IP, many poultry farms came under restriction. As a result, it was difficult for farmers to find storage space for the large number of eggs produced daily within the affected zone. Based on these experiences, and after negative results for these farms were confirmed through surveillance, veterinary officers scaled down the movement control zones to a 5-km radius. This flexible application of movement controls is reflected in the revised *Manual* (12). Legislation was also introduced to compensate poultry farmers within such movement control areas (in this case, the 30-km radius) to ease the financial burden on their farms (11).

Preparedness

In Japan, there are 180 million layer and 104 million broiler chickens, which ensure 96% self-sufficiency for eggs and 67% for chicken meat. Nevertheless, approximately 530,000 tonnes of poultry products and 1.2 million day-old chicks are imported annually. Therefore, a stringent quarantine system is in place at the border to prevent the introduction of exotic diseases into the domestic poultry population. However, the possible incursion of exotic organisms must still be prepared for. It is of paramount importance to establish and maintain a well-organised and competent veterinary diagnostic system so that any disease agent can be quickly isolated, its sub-type identified and phylogenetic analysis rapidly performed. The current system achieved the required measures promptly, at a time of confusion.

Although one local instance of disease spread was identified during the outbreak, one advantage of the poultry industry in Japan is that commercial live-bird markets do not exist. This characteristic probably greatly favours reduced disease spread. In the outbreaks of H5N1 in Hong Kong in 1997 (18), the United States of America in 1985 and between 1996 and 1998 (2), and also in the series of outbreaks in South-east Asia from 2003 to 2004, live-bird markets reportedly acted as a virus distribution point between flocks.

On the other hand, huge numbers of waterfowl migrate to Japan every year, and a large volume of poultry and poultry products are imported. Therefore, Veterinary Services in Japan must pay close attention to surveillance of domestic poultry and wild birds nationwide to detect disease early. Preparations must also be made for more difficult situations, such as multi-focal outbreaks and outbreaks in high-density areas.

These outbreaks have demonstrated that HPAI could spread easily beyond national borders. Since HPAI may have become endemic in South-east Asia, international co-operation to tackle this disease is crucial. International bodies such as the OIE, FAO and World Health Organization have an increasingly vital role to play in facilitating such co-operation.

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Un foyer d'influenza aviaire hautement pathogène dû au sous-type H5N1 du virus, maîtrisé au Japon en 2004

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Résumé

Un foyer d'influenza aviaire hautement pathogène (IAHP) dû au sous-type viral H5N1 est survenu au Japon, affectant quatre établissements de trois préfectures entre janvier et mars 2004. Ce foyer a entraîné l'abattage sanitaire de 274 654 volailles. Il s'agit du premier foyer d'IAHP observé au Japon depuis 1925. (Le foyer précédent était dû au sous-type viral H7N7.) La maladie a été éradiquée avec succès en trois mois et demi, à l'issue d'une campagne d'éradication qui comprenait le dépeuplement des établissements affectés, la mise en place de contrôles des déplacements d'animaux et une surveillance intensive. Les mesures de lutte ont été réalisées conformément aux dispositions du National *Manual of HPAI Control* (Manuel national de contrôle de l'IAHP). Néanmoins, un certain nombre de problèmes ont été constatés lors de la campagne d'éradication, notamment le retard pris par les éleveurs avant de déclarer la

maladie. La législation en la matière et le manuel de prévention ont été révisés en tenant compte de ces observations.

Mots-clés
Asie du Sud-Est – Éradication – H5N1 – Influenza aviaire – Influenza aviaire hautement pathogène – Japon – Manuel – Mesure de lutte – Prévention – Prophylaxie – Surveillance – Volaille.

Control de un brote de influenza aviar altamente patógena causado por virus del subtipo H5N1 en Japón en 2004

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Resumen
En enero y marzo de 2004 se registró en cuatro explotaciones de tres prefecturas de Japón un brote de influenza aviar altamente patógena (IAAP) causado por el subtipo vírico H5N1, a resultas del cual fueron sacrificadas 274.654 aves de corral. Era el primer brote de IAAP que se declaraba en el país desde 1925 (el anterior fue causado por virus del subtipo H7N7.) La enfermedad quedó erradicada en tres meses y medio, tras una campaña que comprendía el sacrificio sanitario total en las instalaciones afectadas, el control de los movimientos y una vigilancia intensiva, medidas todas ellas que se aplicaron conforme al manual nacional de lucha contra la IAAP. Sin embargo, en el curso de la campaña surgieron interrogantes importantes, relativos por ejemplo al plazo de notificación por parte de los productores afectados. A raíz de esa experiencia se han revisado como corresponde tanto el citado manual como la legislación sobre el tema.

Palabras clave
Aves de corral – Control de enfermedades – Erradicación – H5N1 – Influenza aviar – Influenza aviar altamente patógena – Japón – Manual – Medida de lucha – Prevención – Sudeste asiático – Vigilancia.

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