H5N1 HPAI
Global overview - July and August 2010

EMPRES
EMERGENCY PREVENTION SYSTEM

prepared by EMPRES/GLEWS

Please note that because of low H5N1 HPAI activity, this issue covers a two-month period (unlike previous monthly issues). The next issue of the H5N1 HPAI Global Overview will be published in December 2010, covering the period September to October 2010.

Issue No. 24

WORLDWIDE SITUATION

In July 2010, 61 H5N1 HPAI poultry outbreaks were observed in Egypt, Indonesia and Viet Nam. In August 2010, 59 H5N1 HPAI poultry outbreaks were observed in Egypt and Indonesia. No outbreaks in wild birds were reported in either month. The number of reported outbreaks/cases by country and their location are illustrated in Figures 1 and 2, respectively.

FIGURE 1a
H5N1 HPAI outbreaks/cases in poultry/wild birds in July 2010
(Source: FAO EMPRES-i)

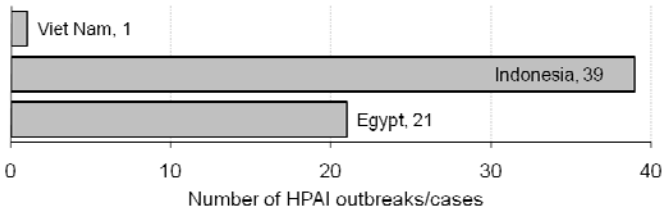


FIGURE 1b
H5N1 HPAI outbreaks/cases in poultry/wild birds in August 2010
(Source: FAO EMPRES-i)

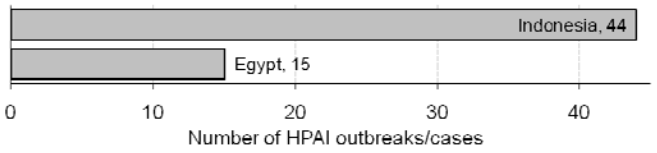
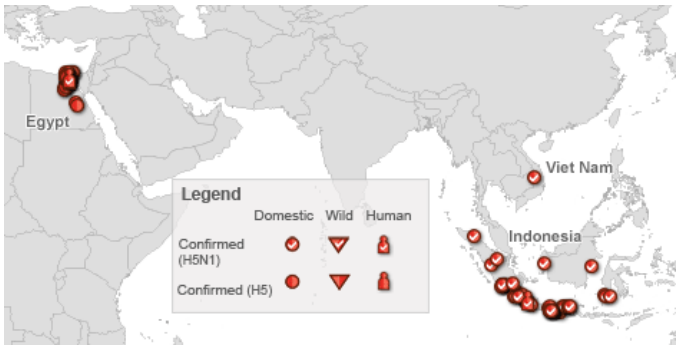


FIGURE 2
H5N1 HPAI outbreaks/cases reported in poultry, wild birds and humans in July and August 2010
(Source: FAO EMPRES-i)



NOTE: H5 cases are represented for outbreaks where N-subtype characterization is not being performed for secondary cases or if laboratory results are still pending. Countries with H5 and H5N1 occurrences only in wild birds are not considered infected countries according to OIE. The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country.

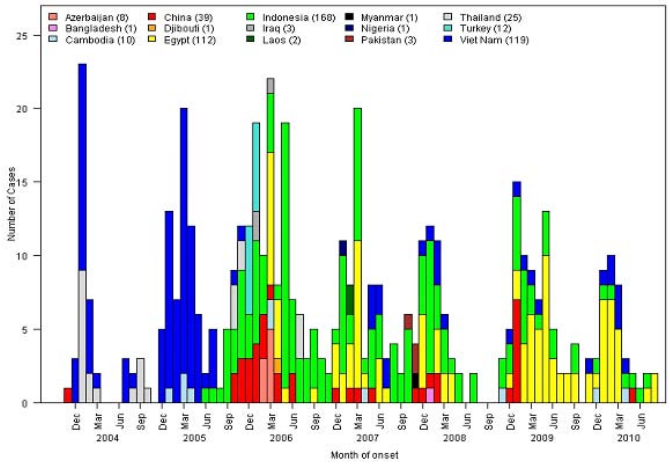
Figure 3 shows the confirmed cases of H5N1 infections in humans reported to the World Health Organization (WHO) by country over time. Between November 2003 and August 2010, 505 human cases of H5N1 infection were reported to WHO from 15 countries, of which 300 were fatal, a case fatality rate (CFR) of 59%. Among the countries with more than ten reported cases, Indonesia had the highest CFR of 83% (139 out of 168). Age distribution of the reported human cases in all countries ranged from three months to 81 years of age (median 18 years of age). Cases between 0 and 9 years of age were most common (29%). The highest CFR (74%) was in persons aged 10-29 and the lowest (25%) in persons aged 70 and above. Gender was equally distributed, with 52% of the cases being females. (Source: Western Pacific Regional Office of WHO, Avian Influenza Update).

TABLE 1
Cumulative number of confirmed human cases of avian influenza A/H5N1 reported to WHO between January 2008 and August 2010
(Source: World Health Organization - WHO)
Note: in red the figures that have changed since the last Global overview

Country	2008		2009		2010	
	cases	deaths	cases	deaths	cases	deaths
Bangladesh	1	0	0	0	0	0
Cambodia	1	0	1	0	1	1
China	4	4	7	4	1	1
Egypt	8	4	39	4	22	9
Indonesia	24	20	21	19	6	5
Viet Nam	6	5	5	5	7	2
Total	**44**	**33**	**73**	**32**	**37**	**18**

In 2009, although the number of cases increased by 65% when compared to 2008, CFR decreased from 75% to 44%. This is mainly influenced by the high number of non-fatal cases reported in Egypt. In 2010, as of 30 June, 37 human cases had occurred, with a 49% CFR.

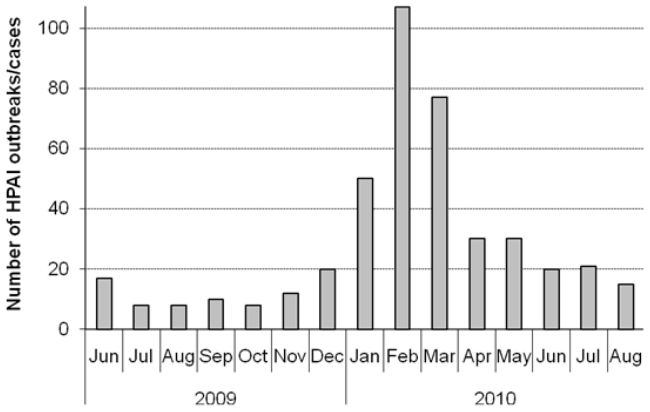
FIGURE 3
Cases of H5N1 AI infections reported in humans by country and month of onset since November 2003
(Source: World Health Organization - WHO)



SITUATION BY CONTINENT/REGION

Africa

FIGURE 4
H5N1 HPAI outbreaks in poultry in Egypt between June 2009 and August 2010
(Source: FAO EMPRES-i)



Egypt reported their first H5N1 HPAI outbreak in February 2006. Despite a vigorous initial response to the disease, including the culling of over 40 million birds, Egypt is considered as an endemic country where outbreaks are regularly reported from different governorates. Circulating viruses belong to Clade 2.2.1 and cluster in two major genetic groups. All the human cases in 2010 are caused by viruses belonging to one of these two genetic groups. Viruses isolated during this period were genetically similar to those isolated in 2009. Data are not available on the antigenic properties of the recent poultry viruses in Egypt, but the human isolates characterized are antigenically similar to one another. These viruses did not react well to post-infection ferret antiserum raised against the vaccine reference viruses used in the country.

In July and August 2010, 36 H5 HPAI outbreaks were reported in poultry (chickens, ducks, geese and turkeys) from Beni Suef (4), Dakahlia (4), Damietta (3), Fayoum (1), Gharbia (1), Kafr-Elshiekh (1) Luxor (1), Minufiyah (5), Menia (2), Qalubia (5), Qena (1), and Sixth October (8) governorates. Of these, 33 outbreaks (92%) were reported from the backyard sector. Two (6%) of the outbreaks occurred in vaccinated flocks and 28 (85%) in non-vaccinated flocks, while the vaccination status of the remaining three outbreaks (9%) was unknown. During the reporting month, Community Animal Health Outreach (CAHO) teams visited 289 villages in 15 governorates and detected five (15%) of the above-reported confirmed outbreaks. CAHO teams operate in high-risk governorates and collect samples only from suspected HPAI cases.

Poultry farms are required to test their birds and receive certification (HPAI infection negative status) prior to any planned transportation. During July and August 2010, a total of 5 703 samples were collected for this purpose and all were confirmed to be negative for HPAI. In Egypt, compliance with certification for poultry transportation is generally sub-optimal and only registered commercial poultry farms (<20% of all farms) seek such services.

During the reporting period (July - August 2010), 27 poultry farms located in ten governorates were subjected to active surveillance and only one was confirmed positive for H5 HPAI infection. Active surveillance was also carried out in 146 villages and 17 of the samples collected from six governorates were confirmed positive for H5 HPAI.

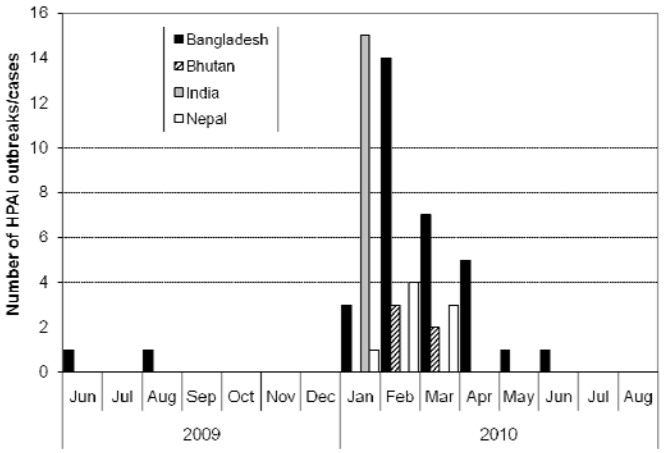
By way of passive surveillance, two of the three HPAI notifications received from commercial poultry farms were found positive for H5 HPAI. In the household poultry sector, 16 of the 114 suspected outbreak notifications received from eight governorates were confirmed positive for H5 HPAI. A total of 99 samples were collected at road check points and all were found negative for H5 HPAI.

The current government policy is to allow commercial poultry farms to vaccinate their flocks with registered vaccines of their choice. Although there are no official data, it is assumed that vaccines are widely used in the commercial poultry sector. All AI vaccines used in Egypt (at least 21) are inactivated (mostly H5N2) and imported. For three years, until July 2009, the government provided vaccination to household/village poultry free of charge; then vaccination was suspended until further notice after an assessment suggested that the programme had limited or no impact on H5N1 HPAI incidence.

In July and August 2010, three human avian influenza (AI) A H5N1 cases were reported: two females of 33 and 20 years of age, from Qaluibia Governorate (both fatal), and a 2-year old female from Cairo. Investigations into the source of infection indicated that the three cases had exposure to sick and dead poultry. Of the 112 human laboratory-confirmed cases of influenza A H5N1 reported in Egypt since the beginning of the epidemic, 36 (30%) have been fatal. While most cases in 2009 were in children under four years of age, so far in 2010, 80% of human infections have been reported in patients above that age. In terms of the CFR, the 2010 total is, so far, much higher than in 2009 (49% vs. 10%) and similar to that in 2008 (50%). The increase in reported H5N1 HPAI outbreaks in poultry (348 in 2010 up to August 2010 compared with 125 in the same period in 2009) is most likely the result of improved surveillance through the effectiveness of the CAHO programme.

South Asia

FIGURE 5
H5N1 HPAI outbreaks/cases in poultry/wild birds in South Asia, by country, between June 2009 and August 2010
(Source: FAO EMPRES-i)



In July and August 2010, **Bangladesh** experienced no outbreaks. Some viral samples, including three isolates from January 2010, were sequenced by the FAO/OIE Reference Laboratory for Avian Influenza and Newcastle disease in Padova, Italy. The phylogenetic analysis showed that all isolates belonged to Clade 2.2. In particular, these isolates grouped in sublineage III and clustered with sequences of viruses from Bangladesh isolated from 2007 to 2009. These results indicate that the virus is being maintained in reservoirs unnoticed within the country. The emphasis of the current policy of the government is placed on early detection and containment by culling, as well as the improvement of bio-security in various production sectors.

As of 31 August 2010, a total of 357 outbreaks had been recorded in 47 out of 64 districts, including 30 outbreaks in

2010, 32 in 2009, 226 in 2008 and 69 in 2007. Out of these outbreaks, 304 were on commercial poultry farms, and only 54 in backyard poultry. Over 1.8 million birds have been culled since 2007. Poultry vaccination against H5N1 HPAI is prohibited by the government. FAO is coordinating and supporting active surveillance that has been expanded to 260 upazillas (sub-districts) across the country, including the innovative use of the Short Message Service (SMS) gateway (method of sending and receiving SMS messages between mobile phones and a computer) as a reporting tool. Daily, in each upazilla, three community animal health workers employed by the active surveillance programme send SMS coded text messages to the Department of Livestock Services, regardless of the presence or absence of disease and deaths in poultry. SMS messages of suspected AI events are automatically forwarded to the livestock officer in the area who will start an investigation. In July and August, 22 166 and 21 597 SMS messages were received, respectively, including 208 suspected HPAI events in backyard poultry and 423 suspected events on commercial poultry farms. The veterinary investigations that followed excluded 572 of these suspect cases and on 59 occasions, diagnostic specimens were collected. Of all specimens collected and reported through the SMS gateway system, none tested positive for H5N1 HPAI.

Eight of 23 migratory waterfowl trapped in Bangladesh in February 2010 as part of an FAO-facilitated satellite tracking project are still delivering data that will allow to further elucidate the role of migratory birds in the spread of H5N1 HPAI. The current location of the birds can be found at http://www.werc.usgs.gov/Project.aspx?ProjectID=159. An article on this project was published in Science (http://www.sciencemag.org/content/vol328/issue5978/r-samples.dtl).

In **Bhutan**, after outbreaks reported in February and March 2010 (the first outbreaks ever reported in the country), no outbreaks have been detected in subsequent months. The disease was controlled by culling affected and in-contact poultry, burning coops, disinfection, and disposal of culled birds and poultry products by burial. Phylogenetic analysis confirmed Clade 2.2, similar to the viruses detected in India and Bangladesh. Antigenically, the viruses from Bhutan and Bangladesh reacted well to post-infection ferret antiserum raised against the vaccine reference virus A/Bar headed goose/Qinghai Lake/1A/2005.

In **India**, after no notification of outbreaks since 27 May 2009 (in West Bengal), a sudden outburst of H5N1 HPAI outbreaks was reported during January 2010 in the Khargram and Burwan blocks of Murshidabad District in West Bengal, all in backyard poultry. However, no outbreaks have been observed since then. The 2010 virus isolates are similar to those of 2008 and 2009: Clade 2.2.

The surveillance activity conducted at the High Security Animal Disease Laboratory (HSADL), Bhopal, is periodically reported at http://www.dahd.nic.in/, including the number of samples received and tested per state. In addition, the Ministry of Environment and Forests of the Government of India and the Department of Wildlife and Forests of Uttar Pradesh are funding the sampling of wild water birds. The 2009-2010 session started on 25 November 2009 and was implemented by the Bombay Natural History Society and the Aligarh Muslim University. Trapping and ringing started in Sheikha Jheel, Aligarh. In total, 2 258 samples (serum, oral and cloacal swabs) from 59 water bird species were collected and sent to HSADL for analysis. Results are pending.

Twelve of sixteen migratory waterfowl trapped in the states of Assam and West Bengal as part of an FAO-facilitated satellite tracking project in January 2010 are still delivering data (http://www.fao.org/avianflu/en/wildlife/sat_telemetry_india.htm). Laboratory results are still pending.

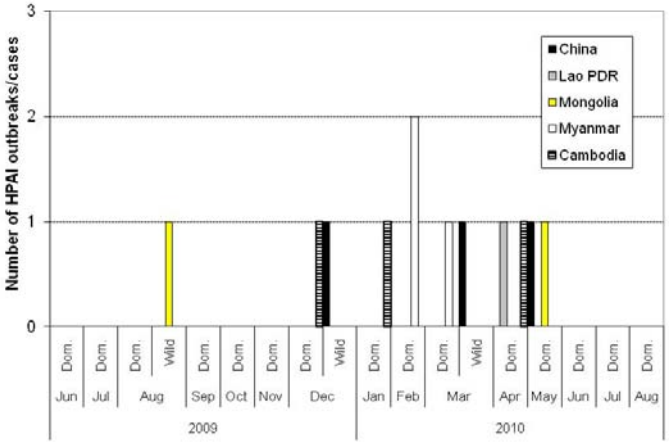
In **Nepal**, no H5N1 HPAI outbreaks have been reported since March 2010. The index outbreak was identified in the Kaski District and detected at the end of January 2010. Though first identified in the Kaski District, the virus was most likely introduced into Nepal in the southern border districts of the Terai and spread, despite control measures, to infect a total of eight districts in Nepal. During February 2010, the outbreaks were detected in Kaski (9), Rupendehi (1), Tanahu (4), Chitwan (1), Banke (3) and Dang (1) districts, all of which border India. March saw additional outbreaks in this border areawith occurrences in backyard poultry in Banke (2), Kailali (2) and Nawalparasi (6) districts. With the exception of three initial samples from the Kaski District that had given H5N1 Clade 2.2, all samples submitted to the Veterinary Laboratories Agency (VLA), Weybridge, produced H5N1 Clade 2.3.2, which is the first detection of this clade in the South Asia region. Clade 2.2 had been already isolated in 2009 in Nepal's eastern region. Clade 2.3.2 viruses were most related to viruses isolated in wild birds in 2009 from the Russian Federation and Mongolia. More distant Clade 2.3.2 viruses were also isolated in wild birds in Hong Kong SAR (China) and in poultry in Viet Nam.

South East and East Asia

FIGURE 6

H5N1 HPAI outbreaks/cases in poultry/wild birds in East and South East Asia, by country (excluding Indonesia and Viet Nam), between June 2009 and August 2010

(Source: FAO EMPRES-i)



In **Cambodia** no additional poultry or human cases have been reported since April 2010, when a 27-year old man from Prey Veng Province died of H5N1 infection. In Cambodia, human cases have alerted authorities to poultry outbreaks. All available human and animal isolates since 2004, including all those from 2010, are Clade 1 and most closely related to Clade 1 viruses previously circulating in Cambodia. This is also the same clade that circulates predominantly in southern Viet Nam.

Cambodia routinely reports results obtained from surveillance activities through two hotlines (supported by FAO until February 2010) at the National Veterinary Research Institute (NaVRI). There is also ongoing duck market surveillance at eight live bird markets (LBMs) in five provinces and sentinel duck flock surveillance in six provinces, both conducted by NaVRI (and supported by FAO). As none of the samples previously collected from 12 markets over two years tested positive for H5N1 HPAI, the number of markets was reduced to eight and, in addition, 12 sentinel duck flocks have been introduced into the surveillance programme.

In **China**, no outbreak was reported in poultry or wild birds during July and August 2010. The last reported outbreak remains that observed in May 2010 in wild birds in Tibet.

In 1996, China first identified HPAI viruses of the H5N1 subtype in geese in Guangdong Province and H5N1 HPAI

viruses have continued to circulate and evolve since then. Almost 200 H5N1 HPAI outbreaks have been reported in poultry and wild birds in 29 provinces since 2004 and a total of over 35 million poultry have been culled to control the spread of the disease. While 2008 was marked by a slight increase in the number of cases in domestic poultry compared with 2007, only two outbreaks were reported in mainland China in 2009 (Xinjiang autonomous region in February and Tibet autonomous region in April), showing a decrease in the number of outbreaks reported since the beginning of the epidemic in 2004. However, official ongoing surveillance activities conducted at national and provincial levels provided evidence that H5N1 viruses were still circulating in many provinces. Out of 225 509 virological samples collected between November 2009 and February 2010, 47 H5N1 viruses in ducks (57.4%), chickens (40.4%) and geese (2.1%) were detected in Anhui, Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan and Zhejiang. Sixty-five percent of all virological samples were collected from chickens, 18% from ducks, 6% from geese, 3% from wild birds and the remaining 8% from pigs and other species. In a number of provinces, the proportion of positive samples was higher than expected, especially for ducks (some over 4%).

The results from the national surveillance system were released in June 2010 by the Ministry of Agriculture and covered the months of December 2009 and January 2010. In the first bulletin (reporting samples collected in December 2009) nine viruses were detected in chickens (5) and ducks (4) in Hunan and Yunnan from the 146 778 poultry samples collected. In the second bulletin (reporting samples collected in January 2010), 38 H5N1 HPAI viruses were isolated from 21 892 poultry samples. These viruses were detected in chickens, ducks and geese in 29 LBMs in 13 provinces.

An intensive, surveillance programme currently ongoing in Hong Kong SAR includes sampling of dead wild birds, wholesale and retail market birds found dead, as well as faecal swabs and pre-sale antibody checks from healthy birds.

China has an enormous poultry sector, with more than 15 billion total production per year and a 5.5 billion permanent poultry population. Mass vaccination against H5N1 HPAI has been implemented since November 2005. Vaccination combined with other measures has resulted in improved disease control. Although the virus is still circulating in many provinces, there has been an apparent reduction in the number of poultry outbreaks since 2004. Between November 2009 and February 2010, out of 1 567 351 post-vaccination samples, 1 385 346 (88.39%) were seropositive.

AI vaccines are provided free of charge by the government to both commercial poultry farms and backyard poultry breeders. China produces its own AI vaccines with ten manufacturers nationwide. Most birds receive the killed “Re-5” vaccine regardless of species. Most poultry should receive at least two doses of vaccine (primary + booster), except for meat ducks and chickens, which have a very short production cycle.

All the clades of Asian-lineage H5N1 HPAI virus found globally have been detected in China. Of particular interest is the recent expansion of Clade 2.3.2, which was originally detected from a dead Chinese pond heron in Hong Kong SAR in 2004 and has now expanded its geographic range to include Mongolia, the Russian Federation, Nepal, Romania and Bulgaria. In Hong Kong SAR, viruses from Clade 2.3.4 were also detected in wild birds and poultry in 2009.

A 22-year old pregnant female from Hubei Province diagnosed with H5N1 influenza A after becoming ill on 23 May 2010, died on 3 June 2010. Investigations into the source of her infection indicate exposure to sick and dead poultry, although no poultry outbreak was reported. Since the beginning of the epidemic, China has reported 39 human cases, of which 26 (67%) were fatal. On average, fewer than ten human cases are reported each year (range: 0 to 13 cases annually since 2003). From January through to early February 2009, eight human cases were reported in Hunan (3), Beijing (1), Shandong (1), Xinjiang (1), Guizhou (1) and Guangxi (1), including in provinces where no poultry outbreak of H5N1 HPAI infection had ever been detected. Disease investigations carried out in the vicinity of these human cases remained inconclusive as to the origin of infection in birds and raised questions about the existence of possible unreported outbreaks or asymptomatic viral excretion leading to human infection in backyard poultry farms or LBMs.

Most recently, a unique new publication by Kou *et al.* (2010) demonstrated the H5N1 virus prevalence in apparently healthy wild birds surveyed between April 2004 and August 2007. Of 14 472 wild birds sampled, covering 56 species of 10 orders in 14 provinces of China tested with RT-PCR using H5 primers, 17 viral strains out of 149 positive samples were isolated. Of the six bird orders affected, Anseriformes had the highest prevalence (2.70%), while Passeriformes had the lowest (0.36%). Among the 24 positive species, mallards (*Anas platyrhynchos*) had the highest prevalence (4.37%). Qinghai Province had the highest prevalence (3.88%), particularly in pintails (*Anas acuta*), mallards (*Anas platyrhynchos*) and tufted ducks (*Aythya fuligula*). Sequence analysis indicated that the 17 isolated strains belonged to five clades (2.2, 2.3.1, 2.5, 6 and 7). The five isolates from Qinghai Province all came from Clade 2.2 and had a short evolutionary distance with the isolates obtained from Qinghai Province in 2005. Additional information can be found at http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0006926.

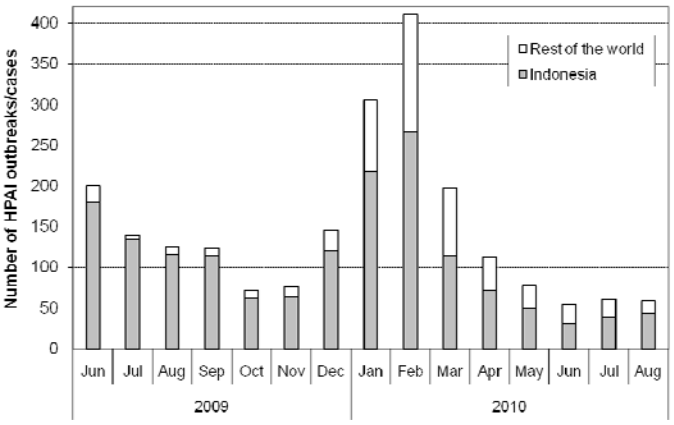
A paper by Jiang *et al* (2010) reports on: (1) the apparent shift towards Clade 2.3.2 viruses as the 'dominant' clade in 2009; (2) the continuing evolution of Clade 7 and Clade 2.3.4 viruses; (3) some changes in the antigenicity of Clade 7 and (to a lesser extent) Clade 2.3.2 viruses; (4) multiple sub-lineages forming within Clade 2.3.2 and 2.3.4; and (5) the detection of Clade 2.3.4 viruses in Xinjiang. A significant number of these viruses were detected in chickens in backyard flocks and markets. The viruses were detected in each round of testing in Guangdong. As antigenic drift of the H5N1 virus continues, it will be necessary to monitor these changes and perhaps develop new vaccine antigens. Additional information can be found at http://vir.sgmjournals.org/cgi/content/abstract/vir.0.023168-0v1.

Indonesia continues to report the majority of the H5N1 HPAI outbreaks in poultry worldwide (Figure 7), as it has for the past three years. H5N1 HPAI Clade 2.1 is confirmed to be endemic on the islands of Java, Sumatra and Sulawesi, and probably Bali, with sporadic outbreaks reported elsewhere. H5N1 HPAI prevalence by village varies widely. Only two of Indonesia’s 33 provinces have never reported the occurrence of H5N1 HPAI. The high number of reports each month is partially explained by the implementation of the Participatory Disease Surveillance and Response (PDSR)* programme that targets village poultry production systems (mainly backyard) and reports evidence of virus circulation in the village. The programme is supported by FAO with USAID, AusAID and World Bank-implemented AHIF-PHRD financial support and is operating in 349 of 496 (70%) districts through 31 Local Disease Control Centres (LDCCs) in 27 (82%) of 33 provinces in Java, Sumatra, Bali, Sulawesi and Kalimantan, including all known endemic areas. Larger and less densely-populated

* In the event that more than one bird dies suddenly in a flock, with or without clinical signs, Participatory Disease Surveillance and Response (PDSR) teams carry out an influenza type A rapid test. A mortality event consistent with clinical HPAI and a positive rapid test in affected poultry is considered a confirmed detection of HPAI in areas where HPAI has previously been confirmed by laboratory testing.

provinces report HPAI outbreaks less often than more densely populated provinces.

FIGURE 7
H5N1 HPAI outbreaks in poultry in Indonesia (compared to the rest of the world) between June 2009 and August 2010
(Source: GoI/ECTAD Indonesia and EMPRES-i)



During July 2010, PDSR officers visited 1 868 villages, of which 53 (2.8%) were infected. Of these, 39 were new infections, while the rest carried over the infected status from the previous month. This infection rate was slightly higher than the June 2010 infection rate of 2.5%. During August 2010, PDSR officers visited 1 488 villages, of which 59 (3.2%) were infected. Of these, 44 were new infections, whilst the rest carried over from the previous month. This infection rate was higher than the July 2010 infection rate of 2.8%. During the previous 12 months, PDSR officers recorded visits in 20 227 villages (28.5%), in the 378 districts under PDSR surveillance. Since May 2008, they have visited approximately 51.3% of villages under coverage. Approximately 6.8% of villages visited during the previous 12 months were classified as infected. Cases over the past 12 months were concentrated in Sumatera, and Java.

The Indonesian Government introduced vaccination in small flocks in mid-2004. Vaccines containing either an Indonesian H5N1 antigen (e.g. A/chicken/Legok/2003) or H5N2 viral antigen have been used in government programmes, and there are now approximately 20 different licensed vaccines. Vaccination programmes by the central government in the backyard poultry sector were implemented until 2008, when they stopped as a result of concern over the efficacy of registered vaccines. In the commercial sectors, vaccination is not coordinated by government, thus vaccination practices there are based on risk as perceived by the farmer. Today, preventive vaccination is practiced in all breeder facilities and on nearly all layer farms nationwide. Single dose vaccination of broilers with inactivated vaccine is practiced sporadically during the wet season on Java. Vaccination of ducks is not widely practiced and the epidemiologic role of ducks in Indonesia remains poorly understood.

A 34-year old female from Banten Province developed symptoms on 2 July 2010, was hospitalized on 4 July 2010 and died on 7 July 2010. Investigations into the source of her infection are ongoing. Of the 168 cases confirmed to date in Indonesia, 139 (83%) have been fatal.

A recent project that conducted surveillance in pigs during 2005–2009 found that 52 pigs (7.4% of surveyed pigs) in four provinces were infected during 2005–2007, but no pigs were infected during 2008–2009. Phylogenetic analysis showed three different introductions into the Indonesia pig population. However, pigs showed no influenza-like symptoms, indicating that influenza A H5N1 viruses can replicate undetected for prolonged periods, potentially serving as intermediate hosts in which the virus can adapt to mammals. More information is available in the paper by Nidom *et al.* (2010) available at http://www.cdc.gov/eid/content/16/10/PDFs/10-0508.pdf

Lao People's Democratic Republic has reported no outbreaks since April and May 2010 in Vientiane, the capital, when the country experienced its first HPAI outbreaks since February 2009. Samples sent to the Australian Animal Health Laboratory (AAHL) in Geelong were identified as Clade 2.3.4, clustering together with viruses seen in Lao PDR previously. The viruses reacted well to post-infection ferret antiserum raised against the vaccine reference viruse A/duck/Laos/3295/2006.

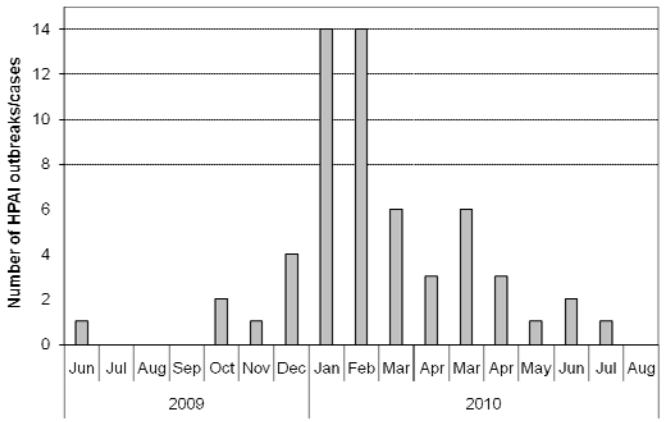
In **Mongolia**, no HPAI event has been reported since the wild bird outbreak reported in May 2010, affecting whooper swans (*Cygnus cygnus*) and greylag geese (*Anser anser*) in Ganga Lake, on the south-eastern border with China. Phylogenetic analyses placed them in the 2.3.2 Clade.

Myanmar has not detected H5N1 HPAI since the March 2010 outbreak in Sagaing Division. Viral analyses of 2010 isolates showed two different clades: Clade 2.3.4 (from the first two outbreaks of 2010), and Clade 2.3.2 (from the last outbreak in Sagaing Division). Clade 2.3.4 is the same clade as the 2007 isolates from the Yangon area, suggesting that this year's outbreaks occurred following a spill-over of virus from a reservoir in domestic duck flocks. However, Clade 2.3.2 had not been found previously in Myanmar.

Myanmar is currently compiling a national database of commercial poultry farms with population and geo-location data to support disease control programmes. Myanmar is implementing an expanded surveillance programme in 78 townships (out of a total of 334). The programme is based on surveillance by community animal health workers, suspect outbreak investigations by veterinary staff, and longitudinal studies of 100 poultry flocks. In the longitudinal studies, sera are collected monthly from ducks and backyard chickens in contact with ducks. To date, there have been no reports of diseases which have required investigation, but the longitudinal studies show that the virus continues to circulate amongst duck flocks.

In **Thailand**, a country that has not experienced any outbreak since 2008, a recent study by Amosin *et al.* (available at http://www.virologyj.com/content/pdf/1743-422x-7-233.pdf) reported on the genetic characterization of the viruses isolated from the outbreaks reported in four provinces. Eight influenza A H5N1 viruses, recovered and characterised, displayed genetic drift characteristics (less than 3% genetic differences). Six out of eight H5N1 isolates were identified as new reassorted H5N1 viruses (between subclades 1.1 and 1.2), while others belonged to an original clade. The estimated point of genetic reassortment of the viruses was traced back to 2006.

FIGURE 8
H5N1 HPAI outbreaks in poultry in Viet Nam, between June 2009 and August 2010
(Source: FAO EMPRES-i)



In **Viet Nam**, H5N1 was first identified in poultry in 2003 and in humans in 2004. In July 2010, just one H5N1 HPAI outbreak in ducks was reported in Thai Nguyen Province, in the northern part of the country. However, there is evidence that there is virus circulation without severe clinical signs, particularly in ducks. Increased stress in poultry and increased movement of poultry due to higher demand in the winter months, including the Tet festival period, possibly help in the transmission of the disease, in which these silent carriers possibly play a key role. Consistent outbreak investigations are not undertaken on infected farms and key information is often missing from the field. FAO is assisting the government in improving the outbreak investigation procedures through the development and updating of standard operating procedures (SOPs) and through Applied Veterinary Epidemiology Training (AVET).

Disease control measures include stamping out on infected farms, movement restrictions for 21 days, compensation and vaccination. Mass vaccination with an H5N1 inactivated vaccine started in 2005 and is implemented throughout the country in two annual campaigns (March/April and October/November), but in some areas, vaccination between the seasonal campaigns is also practiced. The objective is to reach 50% of vaccinated flocks in order to reduce the size of the susceptible population.

Post-vaccination monitoring is routinely carried out after each vaccination campaign. For the second round of 2009, a total of 32 919 samples from 1 138 flocks were collected in 28 provinces for sero monitoring. Results showed that vaccinated poultry have a protection rate† of 64% at bird level, which is significantly higher than the flock level protection (46%). Layers‡ had a higher protection rate at bird level (68%) than meat birds (60%). Chickens showed a higher protection level (68%) than ducks (63%). Serology results also show that titres are slightly higher at two months post-vaccination (compared with samples taken earlier or later) and decrease at four months post-vaccination. For the first round in 2010, field activities were initiated in June-July and no results are available yet.

Desvaux et al. (2010) reported at the “Options for the control of influenza VII” meeting on the “H5N1 avian influenza seroprevalence in North Vietnam under a mass vaccination context”. Around 1 000 birds were sampled for four campaigns (mid-December 2008, end-January 2009, end-March 2010 and early June 2010), from randomly selected poultry farms or villages (for backyard poultry) in the Red River Delta Northern provinces. The global seroprevalence was 18.3%. Muscovy ducks are not usually vaccinated, so if excluded from the calculation, the percentage increases to 22.4%. Broilers, with a short cycle, presented a lower seroprevalence than breeder-layers (11.6% vs. 20.5%). These levels of protection are much lower than the coverage expected from mass vaccination and may be explained by the high turnover of the poutry population, the low duration of the immunity induced by an inactivated vaccine, and practical issues in the field implementation of the vaccination. Some non-vaccinated animals showed seroconversion, which was considered to be due to virus circulation during the study period.

On a similar topic, Henning, J., *et al*. (2010) conducted a longitudinal study from May 2007 to May 2008, monitoring, through bi-monthly testing, 80 flocks of ducks and in-contact chickens in the Mekong Delta of Viet Nam. Serum and swab samples from 5 409 birds were analyzed, showing a bird-level seroprevalence of 17.5% amongst unvaccinated ducks and 10.7% amongst unvaccinated, in-contact chickens. Flock-level seroprevalence (proportion of flock-visits with at least one unvaccinated bird test positive) was 42.6% for ducks and 19.0% for chickens. Only 54.3% of vaccinated ducks and 55.5% of vaccinated in-contact chickens had H5 antibodies three weeks post-vaccination. The flock-level virus prevalence (proportion of flocks with at least one bird positive for H5 virus of the vaccinated and unvaccinated birds tested) was 0.7%. Despite the widespread exposure to H5 virus and the moderate proportions of birds developing positive post-vaccination titres, flocks were not affected by HPAI outbreaks or suspected mortality events during the observation period. The higher bird-level seroprevalence in ducks indicates that they can be an important source of H5 virus for other bird species. The paper can be downloaded at http://www.ncbi.nlm.nih.gov/pubmed/20594603.

Virus circulation surveillance was carried out at the same time as post-vaccination monitoring in 16 target provinces and cities. A total of 1 912 swabs were taken to monitor virus circulation in slaughterhouses and slaughter points, LBMs or households. Thirty-eight out of 449 unvaccinated flocks tested positive for H5 in ten provinces. Two of these flocks (in Quang Ninh and Quang Nam provinces) also tested positive for N1.

Surveillance for AI is a component of numerous projects:

- ACIAR (Australian Centre for International Agricultural Research) project started in June 2006 for three years and includes longitudinal studies to determine the prevalence of past and present infection on smallholder farms in the Mekong River Delta–South Viet Nam. This project has now been completed.
- NZAID (New Zealand’s International Aid & Development Agency) project will run for two years and includes longitudinal studies on nomadic ducks in the Mekong River Delta–South Viet Nam (ongoing).
- CIRAD (French Agricultural Research Centre for International Development) project started in 2007 and includes epidemiological studies in the Red River Delta–North Viet Nam (ongoing).
- VAHIP (Vietnam Avian and Human Influenza Control and Preparedness Project) project is being funded by the World Bank for three years and includes various surveillance activities, including market surveillance for virus circulation and outbreak investigations (ongoing).
- FAO is implementing the USAID- (United States Agency for International Development) funded GETS (Gathering Evidence for a Vaccination Transition Strategy) project, which started in September 2009. This project is running in five provinces. A major strategy in this project involves the implementation of age-based vaccination in ducks, while reducing the vaccination requirements in chickens and enhancing surveillance, monitoring and vaccination of mobile duck flocks.
- Another USAID project is continuing in five pilot provinces (two in the Red River Delta, one in the Centre and two in the Mekong Delta). It includes a biosecurity component and a surveillance component that focuses on enhancing the reporting system, strengthening outbreak investigation and response, and developing a community-based surveillance model with local partners. These surveillance activities are increased in high risk locations and also during certain periods of the year.

Molecular surveillance indicated the presence of four circulating virus clades in Viet Nam since 2003. These are: (1) Clade 1 (predominant in southern Viet Nam and also isolated in Cambodia); (2) Clade 2.3.4 (predominant in northern Viet Nam since 2005 and also circulating in China); (3) Clade 7 (detected in poultry seized at the Chinese border and at markets near Hanoi); and (4) Clade 2.3.2 in 2007 and 2009. Limited sequence data from 2010 indicate that Clade 2.3.2 continues to circulate in Viet Nam. Interestingly, the Clade 2.3.2 HA genes were nearly identical to

† HI ≥ 1/16

‡ there is no data available for different poultry species

A/Hubei/1/2010, which was isolated from a recent human case in China. Clade 2.3.4 viruses grouped into one of two previously identified subgroups with limited genetic variation compared to Clade 2.3.4 vaccine strains. This clade, though largely prevalent in north and central Viet Nam, has also been detected in south Viet Nam in 2010. No new Clade 7 isolates have been detected since 2008.

No human cases have been reported since April 2010, but Viet Nam remains one of the countries with the highest human cases - 119 - of which 59 (50%) have been fatal.

Middle East

In **Israel**, no outbreaks have been reported since two emus at a mini-zoo of a Kibbutz in Hadarom tested positive for H5N1 HPAI in April 2010. Additionally, sequence data recently became available in Genbank for the virus recovered from an outbreak in heavy breeder pullets in Haifa in January 2010. The closest relatives appear to be Clade 2.2 viruses from Egypt.

Europe

The last wild bird event in Europe was reported in the **Russian Federation** in June 2010, when 367 wild birds were found dead in Ubsu-Nur Lake, in Tyva Republic. Genetic analysis at the All-Russian Research Institute for Animal Health (ARRIAH) in Vladimir, determined that the isolate belonged to Clade 2.3.2 of the Asian linage A/Guandong/1/96 and is 99% similar to the 2009-2010 H5N1 isolates from wild birds in Mongolia, Tyva and Qinghai.

Before that, there was H5N1 activity reported by the Black Sea coast, with two outbreaks in backyard poultry in **Romania** and one positive case in a common buzzard in **Bulgaria**. Isolates from both countries grouped in 2010 Clade 2.3.2 and were 99.3% equal to each other and 99.3% similar to viruses isolated recently from poultry in Nepal. Prior to April 2010, the last H5N1 HPAI event in poultry had been detected in October 2008 on a mixed poultry farm in Germany.

Non-infected countries/territories

There have been no HPAI outbreaks reported in **Australia, New Zealand**, the **Pacific Community**, **Papua New Guinea** (outbreaks have occurred in the Indonesian province of West Papua) or **the Philippines**. To date, no outbreaks have been reported in **Timor-Leste**, but here surveillance capacity is weak. In South Asia, **Sri Lanka** and the **Maldives** have not experienced disease. Some Asian countries regularly report negative results obtained from their surveillance activities and suspected cases.

In **Nigeria**, there have been no reported cases of H5N1 HPAI since July 2008. From 2006 to date, the number of positive cases remains at 300.

Iraq, where the last H5N1 HPAI outbreak was in February 2006, has reported recent laboratory results of its surveillance activities for July and August 2010 for all governorates except Kurdistan Province, in the north of the country.

CONCLUSIONS

Since 2003, 63 countries/territories have experienced outbreaks of H5N1 HPAI. The last newly infected country was Bhutan in February 2010 (Figure 9 – upper right corner). Effective control measures for outbreaks in poultry have been associated with reduced incidence of human infections in several countries. However, H5N1 HPAI remains entrenched in poultry in parts of Asia and Africa (Egypt) and thus the risk of human infection remains.

The number of countries reporting outbreaks has been gradually decreasing since it peaked in 2006 (Figure 9 – upper right corner). Surprisingly, 2010 has broken the tendency, and the number of affected countries between January and August 2010 already surpasses that of 2009. When representing the total number of outbreaks reported (Figure 10 – upper right corner) we see a very similar decreasing trend with an increase in 2010. Between January and August 2010, 451 H5N1 HPAI outbreaks were reported, compared to 297 in the whole of 2009. However, when looking at the evolution of the total number of outbreaks reported in each continent, while Asia and Europe show a decreasing trend, which is particularly marked for the latter, the number of outbreaks reported in Africa have been raising over the past two years. Nevertheless, the number of reported outbreaks is a more subjective indicator than the number of affected countries, because it is highly influenced by variables such as the case definition used, the awareness level, the intensity/effectiveness of surveillance programmes in countries and willingness to report. Although there has been an improvement in disease awareness, outbreaks/cases of H5N1 HPAI are still likely to be under-estimated and

FIGURE 9

Number of countries by continent and by month and year that reported H5N1 HPAI outbreaks since December 2003

(Source: FAO EMPRES-i)

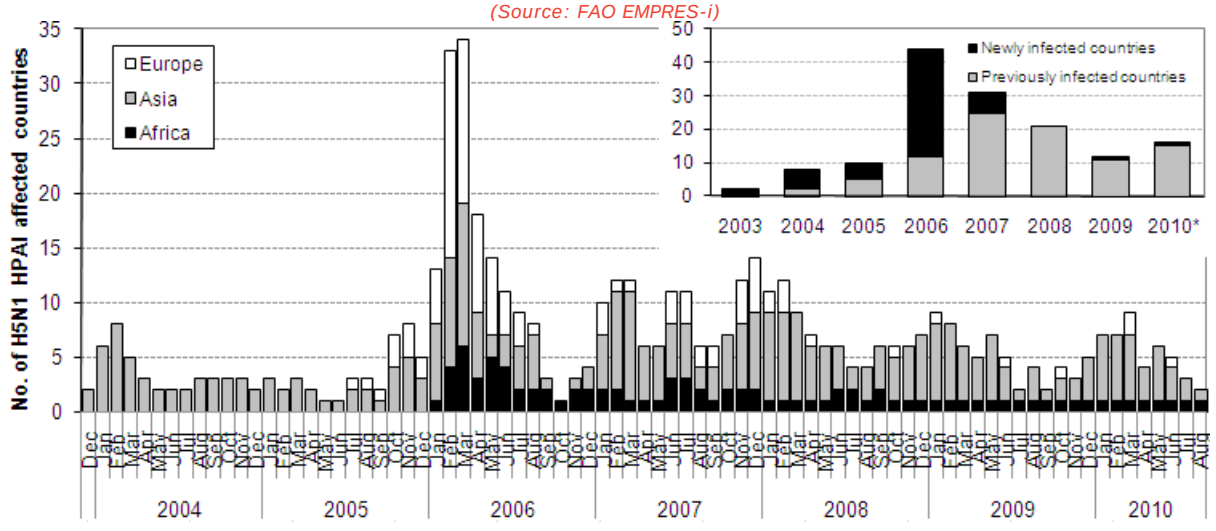
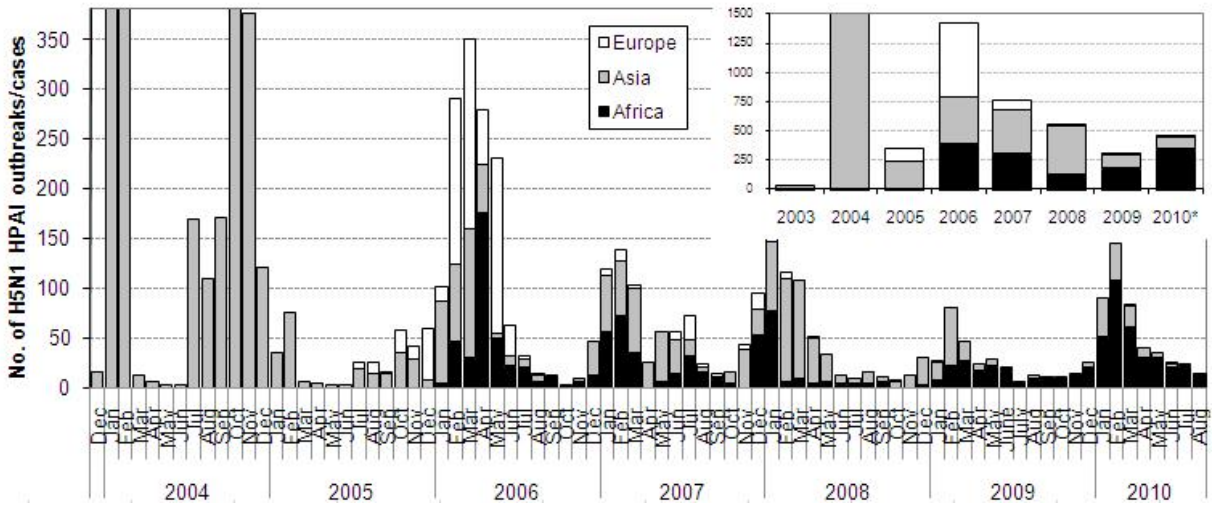


FIGURE 10

H5N1 HPAI outbreaks/cases by continent, by month, since December 2003

(Source: FAO EMPRES-i; Note 1: Indonesia data are not included, because the epidemiological unit definition for the PDSR data was modified from household level to village level in May 2008 and is not comparable); Note 2: Months with more than 380 outbreaks (Jan 04: 1 311, Feb 04: 1 175 and Oct 04: 741), and years with more than 1500 outbreaks (2004: 4 189) have been truncated so that rest of the graph is not distorted)



under-reported in some regions because of limitations in the capacity of veterinary services to implement sensitive and cost-effective disease surveillance, the presence of other endemic diseases with similar clinical signs, the lack of proper outbreak investigations in the field, and the absence or weakness of compensation schemes.

When looking at the seasonal trends, data from previous years have shown a peak during the January-March period in terms of countries affected (Figure 9), number of reported outbreaks (Figure 10) and also human cases (Figure 3). In April 2010, numbers started decreasing following the high activity season, and this trend has continued until August 2010, a month that represents the lowest point so far this year, both in terms of affected countries and number of outbreaks. Even endemic countries such as Bangladesh or Viet Nam reported no outbreaks over July and August, very similar to what happened during the summer months last year. Overall, there is a decreasing trend in the height of the peak as years go by. However, in terms of number of outbreaks (Figure 10), and against the decreasing trend observed since 2004, the peak height reached dimensions similar to the peaks of 2006-2007 and 2007-2008, and considerably higher than the 2008-2009 peak. This is explained by the higher contribution of Africa (Egypt) to the total number of outbreaks (Figure 10), because of the implementation of a more intensive surveillance programme (CAHO), together with the fact that vaccination of backyard poultry was stopped in July 2009. It may also be related to a reduction in the efficacy of control programmes (fatigue).

During 2010, H5N1 HPAI has re-occurred in a number of countries where the disease had not been reported for a number of months, including Cambodia, Israel, Lao PDR, Myanmar, Nepal and Romania. In some cases, molecular evidence suggests introduction of a new strain of virus (e.g. Clade 2.3.2 virus to Romania, Clade 2.2.1 virus to Israel). In other instances, e.g. in southeast Asia, it remains unknown whether the new cases resulted from re-introduction of virus or from detection of outbreaks caused by virus that was circulating at low level within the country without reports of disease or positive findings from surveillance studies.

Aldous *et al.* reported recently on the different relative susceptibility of poultry species to influenza viruses. The study found that following intranasal/intraocular infection of 3-week old chickens, turkeys and ducks with a range of H5N1 and H7N1 HPAI virus doses, turkeys were >100-fold more susceptible to infection than chickens. All infected chickens and turkeys died, while infected ducks were able to survive and thus excrete virus over a longer period (2010, http://www.ncbi.nlm.nih.gov/pubmed/20706882).

Numerous studies have reported the isolation of avian influenza viruses (AIVs) from surface water at aquatic bird habitats. These isolations indicate aquatic environments play an important role in the transmission of AIV among wild aquatic birds. However, the progressive dilution of infectious feces in water could decrease the likelihood of virus/host interactions.

A study by Delogu *et al.* (2010, available at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0011315) investigated if preen oil gland secretions (by which all aquatic birds make their feathers waterproof) could support a mechanism that concentrates AIVs from water onto birds' bodies. They consistently detected both viral RNA and infectious AIVs on swabs of preened feathers of 345 wild mallards by using RT-PCR and virus-isolation assays.

Little is known regarding the persistence of H5N1 viruses in natural settings during outbreaks in tropical countries. Horm et al. (2010) reported during the recent "Options for the control of influenza VII" meeting on the "Environmental contamination during influenza A (H5N1) outbreaks in Cambodia", which investigated various environmental sources surrounding outbreak areas as potential reservoirs for H5N1 viruses. From 175 samples, 42 (24%) tested positive for H5N1 by quantitative reverse transcriptase PCR. Viable viruses were only isolated from three of the 42 (7%), with no correlation between these samples and those with the highest quantity of RNA. Viral RNA was frequently detected in farm soil (66%), pond and puddle water (10%), mud (7%), live poultry cloacal or tracheal swabs (5%), feathers (2%), straw from poultry cages (5%), and poultry faeces (2%). It is important to bear in mind that, the RNA presence does not imply that the virus is still infectious. The longest persistence of viral RNA in the environment was seven days following the last poultry death.

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This overview is produced by the EMPRES/GLEWS team in FAO, which collects and analyses epidemiological data and information on animal disease outbreaks under the framework of the Global Early Warning and Response System for Major Animal Diseases including Zoonoses.
EMPRES welcomes information on disease events or surveillance reports on H5N1 HPAI (and other TADs) both rumours and official information. If you want to share any such information with us please send a message to glews@fao.org. Information will be treated confidentially if requested.