Highly Pathogenic Avian Influenza in Mexico (H7N3)

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A significant threat to poultry production not to be underestimated

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1. OVERVIEW

Other countries at risk, with unpredictable outcomes

The current H7N3 highly pathogenic avian influenza (HPAI) outbreaks occurring in Jalisco, Mexico, demonstrate the constant risk from the circulation of avian influenza viruses to poultry industries throughout the world. In countries that have significant commercial poultry industries, with high numbers of animals living in high-density populations, HPAI outbreaks can cause rapid and severe economic losses to agro-industry and trade. Countries with weaker infrastructure might not withstand shocks to food prices and the resulting food insecurity, especially for more vulnerable households.

This outbreak and its rapid spread through a major production area that also supplies export markets is a stark reminder of the need for constant high levels of biosecurity, and the inherent challenges in actually achieving this, especially in mixed systems where backyard holdings are also present. Robust surveillance systems need to constantly monitor for H5 and H7 subtypes of avian influenza viruses.

While the origin is unknown, it is highly suspected that a low pathogenic strain of a wild bird origin infected domestic poultry.

Ever-stronger alliances combining industry, government and farmers

A robust system that seamlessly combines passive and active surveillance, implemented by the government administration and proactively reinforced by private industry, is a more sensitive model for prevention, early warning and response. Early response should put in immediate motion the response mechanisms to contain a disease outbreak, including the fielding of trained personnel to investigate increased morbidity and mortality in poultry flocks, to conduct examinations of the affected animals, and to take appropriate samples for immediate dispatch to laboratories. Field teams and laboratories should always include avian influenza in the differential testing regime for avian cases.

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Honing response and response times

A timely, agreed upon contingency plan as has been implemented in Mexico through the activation of the National Emergency Animal Health System (DINESA)[1] for this H7N3 HPAI outbreak merits recognition. An emergency plan should incorporate clear responsibilities for the government veterinary services, wildlife officials and specialists, public and private stakeholders (including backyard poultry producers), as well as public health and public information officials, to address animal and human health concerns and food safety in a well-coordinated response. In many epidemics, the first detected outbreaks of disease are found weeks to months after the initial introduction occurred. Often, the clinical findings are initially presumed to be other endemic diseases, and mistreated or addressed on that basis. The authorities are alerted only once other measures have failed and mortalities continue, losing precious time that makes the difference in preventing and controlling the outbreak.

2. AVIAN INFLUENZA VIRUSES AND VIRULENT STRAINS

Avian influenza (AI) type A viruses are the causative agents of one of the most important poultry diseases globally. While low pathogenic avian influenza (LPAI) viruses are maintained in wild aquatic birds, they occasionally spread to other animals and humans and can lead to public health concerns. All 16 hemagglutinin (HA) and nine neuraminidase (NA) subtypes of the influenza A virus are found in wild waterfowl, gulls, and shorebirds, but a much more restricted subset of these viruses is found in other birds and mammals, including humans.

Current classification separates AI viruses in two groups, named for their ability to cause disease and for their degree of severity ("low pathogenic" and "highly pathogenic") in chickens. Today, genetic and virologic information fine-tunes the characterization of viruses into these two groups.

Low pathogenic avian influenza (LPAI) viruses have a tendency to cause damage to the digestive tract and can cause mild illness, often undetected, or show no clinical signs at all. Wild aquatic birds and some species of shore birds are the natural hosts of LPAI viruses. When LPAI viruses are introduced into domestic poultry populations, a slight increase in morbidity and mortality may occur or there may be no apparent signs. Some H5 or H7 LPAI viruses, once in a domestic poultry flock, undergo mutations and can become HPAI.

Highly pathogenic avian influenza (HPAI) viruses can cause a systemic infection, severe clinical signs and high mortality rates (up to 100 percent within 72 hours). The OIE definition of a notifiable HPAI depends on the following criteria: virus strains are considered to be highly pathogenic if they have an intravenous pathogenicity index (IVPI) in six-week-old chickens greater than 1.2 or, as an alternative, cause at least 75 percent mortality in four- to eight-week-old chickens infected intravenously or they are H5 or H7 virus strains with multiple basic amino acids present at the cleavage site of the haemagglutinin molecule (HA0) or if the amino acid motif is similar to that observed for other HPAI isolates[2].

The best known HPAI is the current subtype H5N1, which has caused serious health problems in poultry since 2003 in Asia, Europe, the Middle East and Africa and can cause severe disease in humans. Human disease with H5N1 virus of avian origin is a rare event and human-to-human transmission has not been fully realized.

Although all naturally occurring HPAI strains isolated to date have been either of the H5 or H7 subtype, most H5 or H7 isolates have been LPAI virus strains of low virulence. In outbreaks of HPAI reported in Canada (2004, 2007), Netherlands (2003), and Chile (2002), circulation of an H5 or H7 LPAI was detected shortly before the HPAI outbreak of the same subtype and the resulting HPAI virus was determined to have evolved from the LPAI strain. The change from LPAI to HPAI evolved either through a recombination event or a gradual increase in virulence over time while circulating in domestic poultry populations, through the insertion or substitution of basic amino acids at the HA cleavage site[3]. Due to the risk of a low virulence H5 or H7 becoming highly virulent by mutation in domestic poultry hosts, all H5 and H7 viruses must be reported. Since 2006, isolations of all H5 or H7 avian influenza virus subtypes are notifiable to the OIE.

FAO, in collaboration with other international organizations and institutions specialized in animal health, has provided technical assistance in the prevention, detection, control and elimination of HPAI outbreaks throughout the world, including in the Latin America and Caribbean region, to support the prevention and the control of avian influenza.

3. H7N3 HISTORY

H7N3 AI viruses have been reported worldwide, infecting wild birds and domestic poultry. The last report of H7N3 was of an LPAI virus isolated from domestic ducks in a poultry market in China in 2011[4].

Three major H7N3 HPAI events in poultry occurred in the last 10 years in the Americas: in Chile, in a broiler breeder farm in 2002; in British Columbia, Canada, in a broiler breeder farm in 2004; and in Saskatchewan, Canada, in a broiler hatching egg operation in 2007 (Figure 1). These H7N3 HPAI strains originated from LPAI precursors which, through phylogenetic analyses, each of which showed close relationships with recent H7 viruses isolated from free-flying waterfowl[5,6,7]. The outbreaks were rapidly controlled by sanitary measures (i.e. depopulation and increased biosecurity) along with intensive surveillance[8,9].

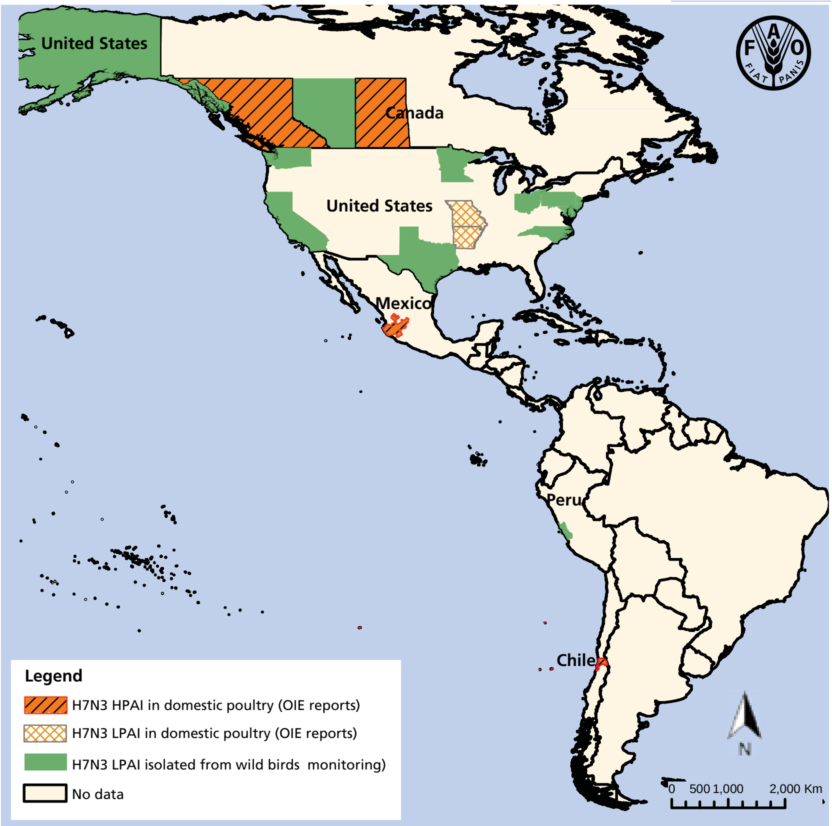
Pakistan experienced several sporadic outbreaks of H7N3 HPAI since the mid-1990s. The first virus introduction was also most likely due to exposure associated with the intermingling of wild bird and poultry populations. The control strategies involved vaccination and culling of infected flocks. Despite these control efforts the virus remains endemic within the country[10].

H7N3 AI viruses are present in wild birds all over the world, which naturally constitute the main reservoir, as demonstrated by monitoring conducted in North America and Peru[11] in South America (Figure 1), as well as Europe and Asia, making wild bird migration and contact with backyard poultry the most frequently identified mode of introduction and/or spread of the virus.

Historically, H7N3 viruses have rarely been reported to infect humans: two cases in Canada, one with the circulating LPAI isolate and the other with the circulating HPAI isolate from the same outbreak in 2004[12], and one case in England from an LPAI outbreak in 2006[13]. When infected, the cases showed mild symptoms characterised by conjunctivitis and possibly mild respiratory illness, and they were primarily reported among persons exposed during the culling of sick poultry. The incomplete or improper use of personal protective equipment (PPE) was associated with the risk of infection[14]. Training and strict compliance with PPE use should be reinforced when outbreaks of avian influenza in poultry populations are being managed to avoid human infection. Additionally, understanding and addressing the obstacles which prevent workers from following well-established recommendations is needed (i.e., better fitting and comfortable goggles, frequent breaks in hot weather conditions, etc.)[15].

In the last five years, H7 LPAI viruses were isolated/detected from domestic poultry in China (Taiwan Province) (H7N3); Denmark (H7N1, 2008, 2010), Germany (H7N3, 2008; H7N7, 2009, 2011), Italy (H7N3, 2008), Japan (H7N6, 2009), Republic of Korea (H7N2, 2009, 2010, 2011; H7N6, 2010; H7N7,

Figure 1. Avian Influenza H7N3 outbreaks reported in domestic poultry to the OIE and H7N3 isolates from monitoring activities in wild birds in the Americas from 2002 to 2012 (OIE, OpenFlu DB)



2010), the Netherlands (H7N7, 2011; H7N1, 2011), South Africa (H7N1, 2009, 2012), Spain (H7N7, 2009), the United Kingdom (H7N7, 2008), and the United States (H7N3, 2008, 2011; H7N9, 2009)[16,17,18].

4. H7N3 HPAI OUTBREAKS IN MEXICO

On 13 June 2012, three outbreaks of H7N3 HPAI were reported in Acatic and Tepatitlán, State of Jalisco, Mexico, an area with high poultry density. The initial reporting event included three commercial layer farms and the establishment of a 40 km quarantine zone. The birds on the infected farms, between 32 and 94 weeks old, showed clinical signs including: gasping, depression, lethargy, drooping wings, prostration, fever and death. During the initial months of the outbreak response, when two infected poultry farms were identified outside the 40 km quarantine zone, at 50 and 65 km east of Tepatitlán, the original quarantine zone was enlarged to 60 km, representing 22 000 km^2. Current epidemiological parameters indicate an incidence rate of 24.6 percent a mortality rate of 9.6 percent and a case fatality rate of 39.2 percent.

At the time of this writing, the depopulation activities of the poultry farms include some 4.9 million birds which have been slaughtered and destroyed out of an estimated population of 9.3 million in the quarantine area. Control measures on the movement of birds, their products and by-products are in place within the quarantine area. Check and surveillance points have been established under the responsibility of the National Service for Health, Food Safety and Food Quality (SENASICA) veterinary staff. As a measure to reduce the risk of further spread throughout the country, sampling is being carried out in neighbouring states and on poultry farms considered at-risk outside the buffer zone.

Intensive epidemiological surveillance activities have been carried out in response to the event in the outbreak area, around the outbreaks and in the buffer zone. As of 24 July 2012, SENASICA investigated and sampled 358 farms with H7N3 virus isolated from 34 poultry farms. Samples from 125 farms have had negative results and the analysis from the rest of the farms investigated are ongoing. The population at risk on these 358 farms amounts to approximately 17 million birds under surveillance in the quarantine zone, of which 60 percent are commercial layer farms, 24.6 percent are broiler farms, 8.5 percent are backyard poultry units and 6.9 percent are breeder farms.

Currently, there are several hypotheses about the cause of the outbreak in Mexico, including a likely wild bird origin

LPAI virus that mutated into a HPAI virus, a wild bird origin HPAI virus or the possibility of introduction through poultry trade. The Animal Health Directorate of Mexico is currently conducting further epidemiological investigations to identify the possible origin.

5. GENETIC PROPERTIES OF THE MEXICAN H7N3 HPAI VIRUS: A/CHICKEN/JALISCO/CPA1/2012

The analysis of HA genetic sequences from H7 viruses demonstrates the apparent existence of three genetically distinct clusters: the North American cluster, the South American cluster and the Eurasian cluster (Figure 2a).

The HA and NA sequence of one of the viruses isolated in Jalisco, Mexico, entered into the GenBank database[19] (JX397993, JX317626) on 20 July 2012 shows that the Mexican H7N3 is most closely related to North American H7N7 LPAI wild bird isolates, with the closest relative being a virus isolated from a wild bird (Northern Shoveler/Mississippi/09OS643/2009) with a 98.2 percent similarity. When comparing the Jalisco virus to other H7N3 viruses via Sequence Similarity Mapping (SSM, OpenfluDB[20]), the two closest viruses are two HPAI Canadian viruses, one from a chicken and one from a human. (Figure 2b). When compared to the North American LPAI wildlife viruses, the Mexican virus only differs at its cleavage site on the HA gene. Analysis shows that a part of the chicken genome has been inserted in the H7 gene, changing the virus from a low pathogenic to a high pathogenic one; a similar event was reported earlier by Khatchikian et al, (Nature, 1989)[21]. This insertion is probably responsible for increased infectivity and pathogenicity of the adapted virus.

6. RESPONSE TO H7N3 HPAI IN MEXICO

The National Mechanism for Emergencies in Animal Health (DINESA) of the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) in Mexico participates in AI surveillance, control and eradication measures and is the structure used for all preparedness and response, developing and implementing the contingency plans for HPAI and other transboundary or emerging animal diseases.

Mexico has in place a Contingency Plan for the Control and Eradication of Highly Pathogenic Avian Influenza in the case of outbreaks in the country, which is being implemented in response to this H7N3 HPAI outbreak in Jalisco. As for poultry health, the public and private sectors work closely together at the policy level, developing the Official Rules for Health Campaigns. At the operational level, Committees for the Promotion and Protection of Livestock and Poultry Health are present in each of the country's 32 States. The staff of the committees are composed of federal and state officials, with budgetary resources contributed annually from a tripartite agreement - federal, state and the commercial sector. These committees are responsible for the enforcement of the sanitary regulations regarding the control of the movement of poultry and their products, as well as for implementing epidemiological surveillance for AI, Newcastle disease and avian salmonellosis.

SAGARPA has a Biosafety Level (BSL) 3 laboratory responsible for the diagnosis of exotic animal diseases and routinely conducts analyses on sera, tissue specimens (including avian cloacal and tracheal swabs), and organs from submitted cases or surveillance programs. Samples from periodic surveillance of commercial and backyard poultry holdings constitute incoming accessions. To support the BSL 3 laboratory, Mexico counts on its network of 19 approved laboratories which also conduct serological and virological diagnosis of AI.

In Mexico, eight vaccine manufacturers are authorized to produce and/or market emulsified killed vaccine against avian influenza, including a laboratory-approved recombinant fowlpox-vectored avian influenza (H5N2) vaccine.

7. MEXICO'S RESPONSES TO HPAI OUTBREAKS

In May 1994, a low pathogenic H5N2 virus (A/chicken/Mexico/26654-1374/94) was isolated from chickens in Mexico, which mutated to a H5N2 HPAI. The control and eradication measures implemented were based on active surveillance, disease detection, depopulation of infected farms, prevention of possible contacts (identified by epidemiological investigations), improvement of biosecurity measures, and restriction of the movement of live birds, poultry products, by-products and infective material. In addition, Mexico introduced a massive vaccination programme, which prevented the spread of H5N2 HPAI in 1994-1995 (383 million doses). Mexico made the declaration of freedom from H5N2 HPAI in December 1995.

The methods of containment, control and eradication of the H7N3 HPAI outbreak implemented by the Veterinary Services of Mexico, according to official notifications sent to the OIE, are technically set according to international standards. Added to this, Mexico has professional skills and experience from having successfully handled and achieved the elimination of the outbreak of H5N2 HPAI between 1994 and 1995. So far, there are no reports that the H7N3 HPAI virus has moved to other states in Mexico and the current outbreak remains contained in the municipal state of Jalisco, where the first notification occurred.

On 27 July 2012, vaccines produced by private and official laboratories in Mexico began to be distributed to the region of Los Altos de Jalisco. A vaccination campaign has begun, with the initial 22 million doses of vaccine aimed to complement the other control measures being instituted. Between 31 July 2012 and the first week of August 2012, an estimated 60 million doses of vaccine will be ready for use in the focal and the perifocal zones. By mid-August, it is anticipated that there will be over 200 million doses of vaccine available. SAGARPA urged poultry farmers to not let their guard down with the introduction of vaccine and that it is essential to continue the same level of strict quarantine, biosecurity and movement control in the affected zone, in order to be successful with the vaccination campaign. Around the middle of August, once about 40 million birds have been vaccinated, post vaccination analysis (antibody response) will be assessed in the vaccinated poultry population. According to the results of this evaluation, a second round of vaccination will begin, in an effort to boost the immune response. Surveillance and control activities, which began once the outbreak was reported, will continue under DINESA to guarantee the biosecurity of the control zone.

Figure 2a. Sequence similarity map of H7N3 viruses for the hemagglutinin gene showing three major clusters

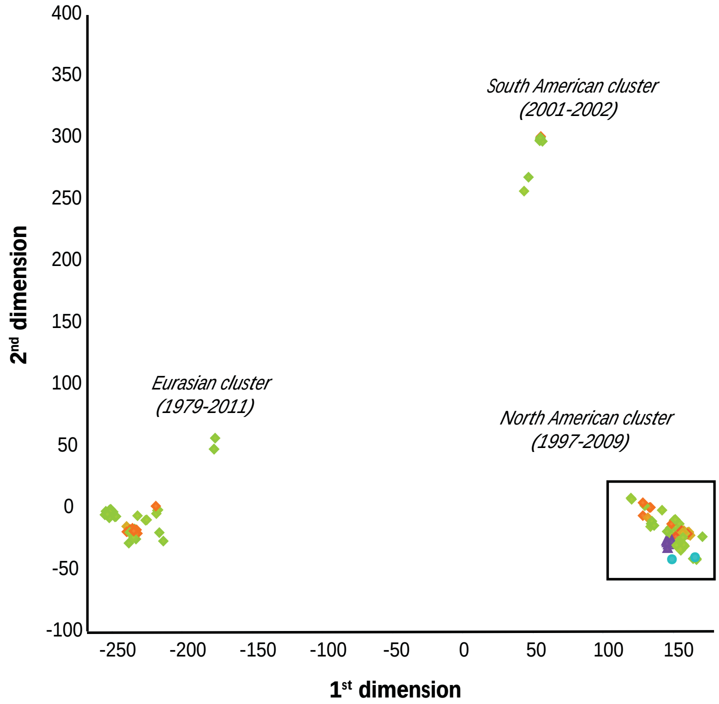
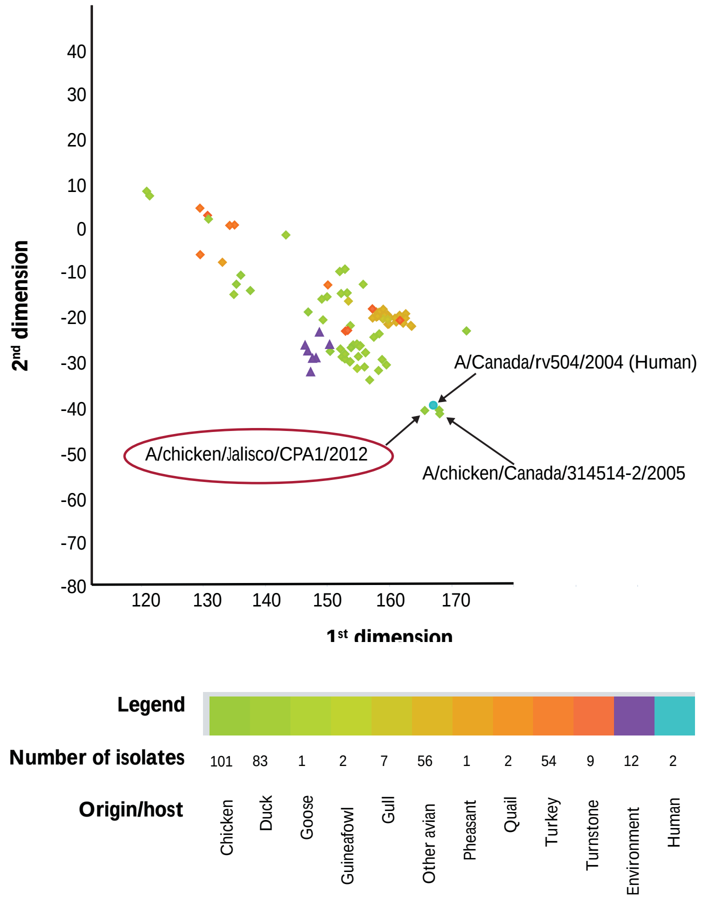


Figure 2b. Sequence similarity map of H7N3 viruses for the hemagglutinin gene according to the host species (source: OpenFlu DB)



8. IMMEDIATE RESPONSE: RISK COMMUNICATION

The government of Mexico mounted an immediate risk communications campaign when H7N3 was first reported to the OIE on 21 June 2012. The National Service for Health, Food Safety and Food Quality (SENASICA) announced a national animal health emergency, thereby activating Mexico's National Mechanism for Emergencies in Animal Health (DINESA) and immediately engaged with the general public to provide timely, transparent information to quell concerns raised by the outbreaks. SENASICA engaged with the media to emphasize to the public that eggs and poultry are safe to eat when properly handled and cooked, and that the government was taking quick action to import eggs and poultry, if necessary, to avoid price shocks. SENASICA created a dedicated website providing all the key information on what biosecurity measures poultry producers can take, complete information about this particular virus as well as background on avian influenza in general. The website is regularly updated and has kept the public abreast of the government's measures, including detailed information on efforts to procure and produce vaccine, and once vaccines were available, SENASICA announced the imminent widescale launch of vaccination campaigns to protect poultry at risk. SENASICA spread the word via social media tools such as Facebook and Twitter, where the Minister of Health, Salomón Chertorivski, tweeted information about the outbreaks to more than 22 000 followers in an example of "One Health" outreach linking the public information efforts of the ministries responsible for human health and livestock. The government of Mexico also worked closely with the Regional Office for Latin America and the Carribbean to issue a regional press release for audiences in the region.

9. THREAT AND ECONOMIC IMPACT OF HPAI OUTBREAKS

Livestock epidemics can result in substantial losses for governments, farmers and all the other participants involved in the livestock production chain. Immediate impacts of a disease outbreak include the cost of policy measures and eradication programs, a reduction in the productive capacity, and a subsequent reduction in the supply of meat and egg products. At the same time, disease outbreaks may reduce the demand for these poultry products, due to public perceptions.

The cost of stamping out, surveillance and vaccination for any disease depends on the at-risk population. The total cost of some epidemics has been estimated for previous HPAI outbreaks (Table 1). The list is not exhaustive, but gives an indication of the cost associated with controlling severe HPAI epidemics. The State of Jalisco, where the 2012 H7N3 HPAI outbreaks are unfolding, is the country's main egg producer and provides 55 percent of the Mexican egg production. According to the National Institute for Statistics, Geography and Informatics, the avian population in Jalisco is composed of approximately 43 million chickens and thousands of turkeys and ducks.

The Americas represent the world's second largest population of chickens after Asia. The continent is the world's largest producer of chicken meat, with 45 percent of the world's production, and is the second largest producer of eggs, with 20 percent of the world's production. Mexico produces close to 2.5 million tonnes of hen eggs, in shell, and 2.9 million metric tonnes of poultry meat, ranking fifth and fourth in the world, respectively, in 2010)[22].

The poultry production systems in Mexico are among the most modern and productive in the world. However, as in all countries, there are also medium-scale farms and backyard poultry production systems, which in many cases focus primarily on household and local consumption. The domestic production of broiler meat in Mexico does not fulfil the domestic consumption, and Mexico imports broiler meat to meet local demand. Mexico also has export markets for broiler meat to other markets, primarily in Asia and Central America. Official forecasts earlier predicted 2012 exports of broiler meat would have been 23 000 MT (metric tons) according to a 2012 USDA report[23].

Mexico is part of the Trans-Pacific Partnership negotiations (TPP), which is a free trade area aimed at increasing exports to Asia-Pacific nations, which are growing markets for services,

Table 1. Estimated costs of some HPAI epidemics

Date and location of outbreaks	Cost
1983/84 Pennsylvania, USA H5N2 HPAI	17 million of birds destroyed US$ 250 million
1997 China (Hong Kong, SAR) H5N1 HPAI	US$ 100 million
1999/2000 Italy H7N1 HPAI	14 million of birds destroyed US$ 620 million
2002 Chile H7N3 HPAI	500 000 birds destroyed US$ 31 million
2003 Netherlands H7N7 HPAI	30 million of birds destroyed US$ 750 million
2003 Karachi, Pakistan H7N3 HPAI	3.2 million of birds destroyed US$ 8.6 million
2004 British Columbia, Canada H7N3 HPAI	17 million of birds US$ 380 million

manufactured goods and agricultural products. Current member countries include Australia, Brunei, Darussalam, Chile, Malaysia, New Zealand, Peru, Singapore, Viet Nam and the United States. With the recent joining of Canada and Mexico, the TPP market will expand to represent 658 million people and a GDP of US$ 20.5 trillion.

10. FOOD SAFETY ASPECTS

Chicken meat is the most consumed type of meat on the continent and the egg is one of the most complete foods available to the low-income sectors, each egg fulfilling about 10 percent of an individual's daily protein needs and containing all essential amino acids. In areas where there are avian influenza outbreaks, poultry can be eaten safely, if cooked and handled properly during preparation. Only healthy birds should be slaughtered for consumption. The virus, if present, is completely inactivated at sufficiently high temperatures during cooking (70°C in all parts of the product for 30 minutes or 80°C for one minute). To date, there is no epidemiological information of human cases infected with AI virus that had followed the consumption of cooked poultry meat or products. There are documented cases of avian influenza infections in people linked to the consumption of raw poultry products (e.g., meals based on raw poultry blood in Asia). It should be noted that consumption of raw poultry products is considered a potential high risk for human infection by other pathogens with greater importance for food safety, including Salmonella spp. or Campylobacter spp.

11. PREVENTION AND GOOD PRACTICES

The primary measures to prevent the introduction of H7N3 HPAI and other pathogens in a country include:

- Establish collaborative mechanisms between the public and private sectors to develop policies and operational procedures for early disease detection and response, including ongoing surveillance activities, contingency plans, compensation structures and policies and immediate reporting of unusual morbidity and mortality events.

- Timely, official reporting to the OIE, neighbouring countries at risk and trade partners about the presence of any H5 or H7 AI viruses.

- Increased surveillance and reporting of disease events with clinical signs compatible with influenza in domestic poultry and wild birds, to improve detection of and early response to avian influenza threats.

- Trained field investigation teams should be aware of the precautions to take to ensure their health (proper use of PPE). Laboratory personnel must observe all safety protocols in the handling of specimens.

- Risk-based surveillance strategies, taking into account variables such as poultry distribution, density of avian species at risk, biosecurity levels, production and marketing systems and frequency of contacts between domestic poultry and wild birds.

- Enhanced capacity for timely reporting, locally and nationally, of increased morbidity and mortality events, followed by rapid epidemiological investigation and disease response to contain spread of infection.

- Ensure that appropriate biosecurity measures are in place on poultry farms, as well as for investigation, response and vaccination teams, so the team members will not be at risk for moving the pathogen from an infected premises to non-infected premises to potentially infect susceptible populations.

- Organize an efficient and effective sample dispatch system, working closely with the investigation teams and the laboratories, to maintain the integrity, identity and source of the samples.

- Institute an effective centralized information system to collect the epidemiological and laboratory data to conduct analyses and prepare reports on the situation for decision makers.

- Institute and assess biosecurity measures at poultry farms and poultry market chains, focusing on movement management, species present, natural and artificial boundaries, formal and informal trade, national and international marketing systems as the major factors used to assess risks and propose target interventions for specific zones or compartments.

- Maintain heightened inspection of poultry and poultry products at ports and borders.

- Enable national systems of compensation and/or compensation for poultry producers, in order to encourage reporting to veterinary services of suspected cases of avian influenza.

- Conduct effective and constant up-to-date risk communications, involving the different production sectors and the general public regarding the results of risk management interventions.

- When considering the use of vaccines, include them as a tool to be used in addition to enhanced surveillance, biosecurity measures, quarantine and movement controls, to minimize production losses until the flocks reach the end of their production cycles. There should be a clear exit strategy designed when vaccination is used, to minimize the risk of undetected continued low-level circulation of AI virus, which has the chance to escape to new susceptible populations. Wild bird surveillance activities should be included and maintained in ongoing programs of surveillance of AI in poultry, in order to monitor the presence of AI viruses in the area with potential significance to poultry.

12. USE OF VACCINES IN RESPONSE TO AI OUTBREAKS

The use of vaccines, inactivated type or recombinant, is a proven method to control AI when implemented properly and only as a tool in conjunction with strict epidemiological surveillance and biosecurity measures in place to ensure containment and elimination of circulating field viruses in poultry production systems. Vaccination can boost the overall immunity of the flock, which will minimize the morbidity and mortality associated with LPAI and HPAI viruses. The expected results of vaccination on the dynamics of infection are to reduce susceptibility to infection and the amount of virus propagated. The decrease in the amount of virus spread is an important aid to eliminate the HPAI virus in poultry populations. When there is an outbreak of avian influenza in an area with a high population density and where the application of biosecurity measures are not applied in all production systems, poultry vaccination can be considered as an option to lessen the environmental viral load, thereby decreasing the spread of infection. The use of vaccine as a control measure should be utilized in a strategic manner, most effectively accomplished if maintained as the responsibility of the national veterinary services, whose decisions are based on the epidemiological situation, risk analysis, commercial and economic considerations. Continual use of avian influenza vaccine without constant assessment of its effectiveness against the circulating viruses may place pressure on the virus to undergo increased genetic drift and to accumulate mutations, which might eventually lead to development of a new HPAI strain against which the vaccine in use is not effective[24].

If national contingency plans foresee emergency vaccination as an option, especially in those countries with a significant poultry industry, the establishment of vaccine banks should be considered. It is important that vaccines be selected based on effectiveness of protection against the circulating avian influenza strain, and their potency and safety established. Imported vaccines should meet or exceed OIE international standards.

The decision to implement a vaccination campaign should also contemplate its eventual withdrawal following the emergency. The exit strategy would include strengthened surveillance and immediate reporting to authorities of any suspect cases of viral activity. Maintaining vaccination campaigns is costly and may lead to continued low-level circulation of undetected virus in poultry populations.

The outbreak of H7N1 LPAI in Italy (2000-2001) is an example where the outbreak was successfully controlled with a vaccine containing an H7N3 seed virus of Pakistani origin. The use of a heterologous vaccine with the N3 antigen allowed to differentiate infected birds from those that had been vaccinated by laboratory analysis (DIVA testing).

13. RECOMMENDED ACTIONS WHEN RESPONDING TO AN OUTBREAK

When AI outbreaks occur, efforts need to be focused on the containment of the problem at the source, minimizing the chance for spread and minimizing the chance for low pathogenic viruses to have the conditions needed to become highly pathogenic viruses. In HPAI outbreaks, control should include quarantine, culling and depopulation, poultry movement control and increased biosecurity (cleaning and disinfection of facilities). Establishing transparent communications to the public and producers and proper compensation to farmers facilitates reporting, disease control and confidence.

Establishing quarantine measures are critical to prevent the spread of AI. Epidemiological surveillance in the field is essential for the detection and containment of outbreaks.

Globally, when these methods have been used, there has been a successful control of the disease, such as the eradication of outbreaks of highly pathogenic H5N2 virus in Pennsylvania (1984) and Texas (2004), and outbreaks of H7N3 in Chile (2002) and Canada (2004), which included early diagnosis, the culling of infected poultry with subsequent cleaning, disinfection, and allowing the facility to stay empty for a period of time, followed by confirmation that the virus is no longer present, using sentinel birds before restarting operations.

The following are links to FAO manuals addressing technical assistance in the areas of good emergency management, prevention, detection, control and elimination of HPAI outbreaks throughout the world and post outbreak rehabilitation, using safe and good agricultural practices.

1. *Good Emergency Management Practice: The Essentials.* FAO Animal Production and Health Paper, No. 11 (available at http://www.fao.org/docrep/014/ba0137e/ba0137e00.pdf)
2. *Good emergency management practices: SOP for HPAI response* (available at http://www.fao.org/docrep/015/i2364e/i2364e00.pdf)
3. *Preparing for Highly Pathogenic Avian Influenza*. FAO Animal Production and Health Manual, No. 3 Revised Edition (available at ftp://ftp.fao.org/docrep/fao/012/i0808e/i0808e.pdf)
4. Wild bird highly pathogenic avian influenza surveillance - Sample collection from healthy, sick and dead birds. FAO Animal Production and Health Manual, No. 4 (available at ftp://ftp.fao.org/docrep/fao/010/a0960e/a0960e00.pdf)
5. Biosecurity for Highly Pathogenic Avian Influenza - Issues and options. FAO Animal Production and Health Paper, No. 165 (available at ftp://ftp.fao.org/docrep/fao/011/i0359e/i0359e00.pdf)
6. Guidelines to avoid human exposure and infection are provided by WHO and the European Centre for Disease Prevention and Control (available at http://ecdc.europa.eu/en/healthtopics/Documents/2031_Guidelines-human_exposure_HPAI.pdf)
7. Understanding Avian Influenza (available at http://www.fao.org/avianflu/documents/key_ai/key_book_ch2.htm)

14. REFERENCES

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Official government information regarding the H7N3 HPAI outbreaks and response in Mexico can be found at the following link:

http://www.senasica.gob.mx/?Idioma=1&id=4663

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