



Investigation of a Highly Pathogenic Avian Influenza Outbreak in a Poultry Farm, Dhamrai, Bangladesh, 2017: a One Health Approach

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Abstract

In January 2017, a highly pathogenic avian influenza (HPAI) A virus killed 732 chickens in a farm in Dhamrai, Bangladesh. An investigation assessed transmission of the virus from chickens to farmworkers. Contacts were farmworkers with direct exposure to affected chickens. We interviewed all suspected cases, conducted an active case finding for human cases at the implicated farm and local clinics, and actively searched for carcasses of wild and domestic birds within two kilometers of the implicated farm. All contacts were asymptomatic and had buried dead poultry; 70% touched dead poultry and 29% used protective gloves while working. Nasal and throat swabs were negative for influenza A and B viruses (subtyped for M-gene positive influenza A viruses by PCR and seasonal H3, H1N1 pdm09, and avian H5/H7/H9). The virus was probably introduced to the farm when ducks from the farm were taken to a live bird market and unsold ducks were returned to the farm. While farmworkers were exposed to the infected chickens, there was no evidence of the virus being transmitted to workers. We recommend starting H5N1 surveillance in live bird markets to monitor HPAI.

Keywords: HPAI, outbreak investigation, biosecurity

Introduction

Highly pathogenic avian influenza (HPAI) viruses have a high mortality in poultry. The H5N1 strain was first isolated from geese in China in 1996.^{1,2} The first outbreak in a poultry farm occurred in Hong Kong in 1997.³ The first documented avian H5N1 in poultry in Bangladesh occurred in 2007 and by December 2012, 556 outbreaks were reported; 89.8% in commercial farms and 10.2% in private farms.^{4,5}

The first human case of HPAI (H5N1) was reported in Hong Kong in 2007 with the source identified as a goose.^{2,4,6} From 2007 to 2020, the World Health Organization (WHO) reported 861 human H5N1 cases and 455 fatalities.⁷ In Bangladesh, the first human case occurred in 2008 and by 2020, there were eight cases with one death.^{7,8} In a study of live bird markets (LBMs) in Dhaka, samples were collected from over

2,000 suspected human avian influenza cases and 61 had detectable avian influenza virus in their RNA (12 H5, 26 H9 and 6 H6/H9 co-detection and 17 A/unsubtypable) from direct contact with infected poultry.⁹

To reduce transmission of HPAI, poultry farms follow the World Organisation for Animal Health (OIE), the Food and Agriculture Organization (FAO), and the WHO recommendation for vaccinating poultry and other control methods such as wearing personal protective equipment while handling poultry, controlling rodents with fencing, and using foot baths at entry points of poultry sheds.¹⁰⁻¹³

On 16 Jan 2017, an outbreak due to the H5N1 virus in a commercial chicken farm in Dhamarai, Dhaka, was reported (Figure 1). This investigation aimed to identify poultry to human transmission of H5N1 and determine the possible source of this outbreak.



Figure 1. Location of the infected poultry farm, Dhamrai, Bangladesh

Methods

The investigation was conducted from 17 to 31 Jan 2017 in Dhamarai, Dhaka and used a mixed method concurrent triangulation strategy. Qualitative methods consisted of field observations and interviews of cases, their contacts, and veterinarians. Quantitative methods consisted of descriptive epidemiology of cases and laboratory tests.

Our multi-sector investigative team included a veterinarian, entomologist, and physician. We expanded the scope of the investigation to include observations of operations in a LBM, walk-through surveys in the implicated and nearby farms, visiting clinics to identify additional cases, and a search for dead birds in the surrounding area.

Definitions

Suspected human case was any person residing within 500 meters of the affected farm with fever ($>37^{\circ}\text{C}$), cough, and difficulty breathing between 14 and 31 Jan 2017.

Human contact with poultry was any person who touched sick or dead poultry or visited the affected farm during the outbreak and participated in the culling of birds between 14 and 17 Jan 2017.

Data Collection

A questionnaire was developed to collect information on the affected farm. The questionnaire for contacts

included socio-demographic characteristics, exposure and contact history, symptoms, and farm working activities before and after the outbreak. The farm owner and poultry workers were interviewed face-to-face. Farm biosecurity practices were examined against the guideline of the Department of Livestock (DLS) and the FAO.¹⁴

We interviewed community residents to ascertain if they noticed any unusual deaths of poultry or wild birds. We also interviewed other key informants such as poultry supply dealers, livestock service providers, and veterinary field assistants. We actively searched for dead birds within a 2-kilometer radius.

During the visits to the farms, we looked for the presence and use of personal protective equipment by poultry workers.

Active Case Finding for Infected and Dead Birds and Humans Who were Sick

We asked the farm manager of the implicated farm to list all farms within a two-kilometer radius, and provide us with the names and telephone numbers of the managers in order to inquire about the health conditions of the poultry and workers. We searched for patients with influenza-like symptoms at the Upazila Health Complex at Dhamrai. We followed up every poultry worker daily for two weeks by telephone and inquired about their symptoms.

Laboratory Investigation of Exposed Poultry Workers

We collected nasopharyngeal and oropharyngeal swabs and blood samples from all contacts. Samples were tested at the National Influenza Center, Institute of Epidemiology Disease Control and Research (IEDCR) for influenza A and B viruses with subtyping of M-gene for seasonal H3, H1N1 pdm09, and avian H5/H7/H9 by real-time reverse transcription polymerase chain reaction (RT-PCR) assay.¹⁵ Antigen detection was carried out at the National Influenza Center, IEDCR by immunofluorescence or enzyme immunoassay methods.¹⁵

Statistical Analysis

The data were entered into a spreadsheet and imported into Stata (version 14, College Station, Texas) for analysis. The mean number and percentage of dead birds were recorded and the morbidity and mortality rates were calculated.

Ethical Approval

As the investigation was performed under the government order by the IEDCR, Ministry of Health and Family Welfare (MoHFW) and Department of Livestock Services, Bangladesh, ethical approval was waived.

Results

Case Finding for Farmworkers and Sick or Dead Birds

The field investigation team arrived in Dhamrai on 16 Jan 2017 and met with the farmworkers and veterinarian. They reported that 56 chickens had died on 14 Jan, and by 17 Jan, 732 (24.4%) had died. The veterinarian collected nasal and oropharyngeal swabs and blood from the dead and live chickens. Testing by the Bangladesh Livestock Research Institute (BLRI) confirmed H5N1.¹⁶ All dead chickens lived in two sheds, which housed a total of 3,000 Sonali chickens. A third shed housed 100 ducks. The chickens were kept in their sheds 24 hours/day while the ducks were allowed to roam around the farm during the day but were kept in their shed at night.

There were 43 people who worked on poultry farms, including the implicated farm, within a two-kilometer radius from the implicated farm. Of these, only seven workers, all from the implicated farm, had had contact with chickens, which were later confirmed to be infected with H5N1. None of the ducks on the implicated farm were symptomatic. The farm managers in this area reported that they had seen no sick birds, that they had not noticed an increase in the number of dead birds, and that none of their workers felt ill in January 2017.

Characteristics of the Contacts

The seven workers from the implicated farm were classified as contacts. Six were male and the median age was 30 (range: 21-45) years. Most worked on the farm for 1-2 years (Table 1). The farm owner visited the farm during the outbreak and was also classified as a contact. However, the investigation team was not able to get detailed information of the farm owner.

Table 1. Socio-economic characteristics of the human contacts exposed to a H5N1 outbreak in a poultry farm in Dhamrai, Dhaka, 2017 (n=7)

Characteristics of contacts	n (%)
Age (years)	
21-25	2 (29)
26-30	1 (14)
31-35	1 (14)
36-40	1 (14)
41-45	2 (29)
Gender	
Male	6 (86)
Female	1 (14)
Education	
Below secondary	3 (42)
Secondary	2 (29)
Higher secondary	2 (29)
Working Experience (years)	
1-2	4 (58)
3-4	3 (42)
Monthly Income (in Bangladeshi Taka (BDT) and US dollars)	
<20,000 BDT (<\$235.29)	3 (42)
20,000-25,000 BDT (\$235-\$294)	2 (29)
>25,000 BDT (>\$294)	2 (29)

Exposure of Contacts to Poultry

The eight contacts were two veterinarians, five poultry workers, and the farm owner. The veterinarians conducted a post-mortem of the 56 dead chickens who died on day 14 and provided ciprofloxacin or azithromycin and oral rehydration to the remaining birds. The poultry workers performed daily activities related to poultry husbandry such as feeding and watering the poultry and cleaning the floor and cages.

All five workers lived on the farm and worked eight hours per day, seven days per week. The two veterinarians rotate their time at the farm and collected the dead chickens from the shed during the outbreak. The workers and veterinarians used thin plastic gloves, rubber boots and aprons while performing their duties. The workers did not wear masks or hoods nor were they trained in poultry

husbandry. The veterinarians reported that they had farm biosecurity training but the team did not observe that biosecurity measures were practiced (Table 2). The most significant observations of poor biosecurity were that feces were present on the floor and cages of the sheds. Litter was moist and foot baths lacked potassium permanganate. Food and water was mixed with feces and bedding materials, and large cracks appeared in walls, allowing rodents to easily enter.

Table 2. Distribution of biosecurity measures practiced by contacts, HPAI outbreak, Dhamrai, Dhaka, 2017 (n=7)

Measure	n
Activities done by poultry workers on the farm	
Contact with dead poultry	7
Contact with sick poultry	7
Feed poultry	5
Clean floors	5
Clean cages	5
Clean the feeding tray	5
Slaughter the poultry	3
Expose the post-mortem of dead poultry	2
Expose during culling	7
Mean working hours/day (hour)	8
Medicate sick poultry	5
Use of protective measures during dead poultry handling and culling	
Mask	0
Plastic gloves	7
Apron	2

Clinical Features and Laboratory Results of Contacts

The average body temperature of the contacts was $36.7 \pm 0.21^\circ\text{C}$. None reported influenza-like symptoms either during the outbreak or at any time over the next 14 days. All nasopharyngeal and oropharyngeal swabs of the seven contacts were negative for H5N1. We did not collect any sample from the farm owner.

Possible Epidemiological Link of the Outbreak

There were no migratory birds in a nearby lake and no history of any deaths in chickens previously on the farm. However, on 7 Jan 2017, the farm manager took the ducks to a nearby LBM for sale. Some unsold ducks were brought back to the farm and were housed close to the poultry shed. All of the ducks appeared to be asymptomatic.

The investigation team interviewed residents who lived near the poultry farm and all said that they had observed no unusual death of poultry or wild bird in the local community or in ponds, rivers, or wetlands. The team also actively searched for birds and poultry carcasses surrounding a 2-kilometer radius of the

outbreak farm and followed up the surrounding community for the next 14 days. No dead birds were observed.

Discussion

This study presented evidence that an H5N1 outbreak occurred among chickens but not in humans despite their direct contact with the birds and despite poor biosecurity measures on the farm. The source of H5N1 was probably a live bird market. This premise is based on the fact that ducks from the farm were taken to the market and when the unsold ducks were returned to the farm, some of the chickens died seven days later. Additionally, there was no evidence of other deaths of birds near the farm and no deaths on the farm before the ducks were taken to the market.

Despite direct contact with the infected chickens, no farmworker developed any symptoms. In Bangladesh, unusual deaths of chickens in commercial poultry farms have been previously reported. Until 2019, 556 avian influenza A outbreaks occurred among chickens resulting in eight human cases.¹⁷ In Thailand, a nationwide surveillance in 2004 revealed 610 H5N1 outbreaks with 12 confirmed human cases, of which eight reported having direct contact with dead chickens.¹⁸ Similar reports have been seen in Vietnam and Hong Kong.^{3,19} In all of these outbreaks, there was no human-to-human transmission. However, human-to-human transmission of H5N1 occurred in a Hong Kong health facility and a family cluster in Northern Sumatra, Indonesia and Eastern Turkey.^{20,21}

Live bird markets in many developing countries are considered a hotspot of avian influenza virus transmission.²² These markets can also sell other goods. People shopping in mixed markets can become infected with avian influenza if they have close contact with infected birds. Avian influenza virus has an incubation period of 3-5 days in chickens, during which time infected birds may unknowingly be traded before they show signs or symptoms of an illness.²³ The HPAI H5N1 viruses can propagate silently among domestic and wild ducks.²⁴ From a surveillance program conducted from July 2006 to August 2007 in LBMs in central Thailand, H5N1 was isolated from two healthy ducks.²⁵ According to the Food and Agricultural Organization, LBMs play an important role in the spread of viruses in poultry workers or susceptible hosts in South Asian countries because of poor biosecurity practices.¹⁰ The FAO has been promoting the improvement of biosecurity measures in LBMs in Bangladesh since June 2009.²⁶ Despite not being able to identify any other birds, domestic or wild, that died before the outbreak, we

assume that the H5N1 strain was transmitted to the ducks at the LBM and carried by the unsold ducks to the poultry farm thereby infecting the chickens. A follow-up study in the implicated LBM and others nearby isolated the H5N1 virus from waterfowl, dead crows, and environmental samples from the markets and concluded that HPAI viruses circulated in these markets.²⁷

Public Health Action and Recommendations

Every H5N1 outbreak in poultry is an opportunity to examine the bird-to-human and human-to-human transmission of a potentially deadly respiratory pathogen. The Bangladesh Government has made great efforts to control avian influenza over the last decade. However, the virus has persistently prevailed and caused sporadic infections and continues to be a public health problem. The biosecurity status of large commercial-scale poultry farms should be strictly maintained. Live bird markets are a likely source of HPAI. As such, proper isolation, containment, and quarantine should be practiced with poultry in and around the market. The Upazila Livestock Office should conduct an active H5N1 surveillance in all LBMs at Dhamrai to screen for sick or dead poultry species, confirm the agent, and enforce biosecurity related to the market.

Although all of the workers wore inadequate personal protective equipment, none developed avian influenza infection. Nevertheless, proper protective equipment is necessary to prevent the transmission of many infectious diseases. Improving biosecurity practices in a commercial poultry farm and wearing personal protective equipment is necessary to prevent poultry-to-human transmission.

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Suggested Citation

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