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Epidemiologic and Other Analyses of Indiana HPAI/LPAI-Affected Poultry Flocks:

March 4, 2016 Report

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I. EXECUTIVE SUMMARY

In mid-January, a combined outbreak of highly pathogenic avian influenza and low pathogenic avian influenza (HPAI and LPAI) occurred in Indiana. The outbreak in commercial turkeys was first detected by an increase in mortality followed by laboratory confirmation of H7N8 HPAI. After initial efforts to control the disease, a series of epidemiologic, geospatial, genetic, and wildlife investigations was started. These studies are being conducted collaboratively with the poultry industry, the Indiana State Board of Animal Health, and the Animal and Plant Health Inspection Service (APHIS). This is a preliminary report of the findings available to date to assist in understanding the introduction and disease transmission pathways. Ultimately, the goal is to reduce the risk of continued spread in this outbreak and to help in future efforts to prevent disease incursions. The information in this report will be updated as more data are collected and analyzed.

Genetic analyses determined that all H7N8 viruses detected from this event are of North American wild bird lineage, and the HPAI and LPAI viruses are highly similar across all eight genes excluding the multi-basic amino acid insertion at the cleavage site in the HPAI virus.

An investigation of cases using an in-person administered questionnaire examined physical and management characteristics of infected premises. The initial analysis indicated some activities found to be risk factors associated with disease in the H5 2015 outbreak were not being practiced in Indiana. However, some activities practiced in Indiana were associated with disease in the 2015 outbreak. Similar information is currently being collected on non-infected farms to help further interpret the infected case data.

APHIS has begun sampling and testing of wildlife near infected premises. Initial results have not found evidence of existing virus in the samples from wild birds and mammals tested to date.

Preliminary geospatial analysis looked at county-level factors that may have contributed to the introduction of the virus into Dubois County, Indiana. The weather in Dubois County was warmer and wetter than past years, which may have contributed to the introduction and persistence of the virus. More detailed geospatial analysis is ongoing.

APHIS will continue to investigate how the HPAI/LPAI virus was introduced and spread and will provide updated results regularly.

II. INTRODUCTION

In 2015, the United States experienced the largest animal health emergency in history. Many lessons were learned from that experience, including the need to understand the outbreak to help prevent and control future outbreaks. Since the end of the outbreak in the summer of 2015, the United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS), States, and the poultry industry have been preparing on many fronts for potential outbreaks in the fall of 2015 or in 2016. The January 2016 combined outbreak of highly pathogenic avian influenza and low pathogenic avian influenza (HPAI and LPAI) in Indiana has challenged the preparations all the groups have made. In response to the outbreak, APHIS Veterinary Services (VS) – in collaboration with the Indiana State Board of Animal Health and the southern Indiana poultry industry – has undertaken a number of epidemiologic, geospatial, and laboratory-based investigations.

These investigations include:

- A field-based study of cases using data collected through personal interviews with farm personnel;
- geospatial analyses;
- on-farm sampling of wildlife; and
- phylogenetic investigations

This report summarizes the preliminary findings from these studies. As investigation and analysis efforts continue, this report will be updated with recent results in an effort to provide producers, industry, and other stakeholders information on how the disease may have been introduced and spread to help with current and future mitigation efforts.

III. GEOSPATIAL ASSESSMENT FOR HPAI/LPAI H7N8 OUTBREAK

APHIS completed a county-level analysis on available data for Dubois County, Indiana, and surrounding counties. The focus was on descriptive epidemiology that could explain why Dubois County experienced an HPAI and LPAI outbreak of H7N8 in early 2016 based on available geospatial data. The analysis focused on the introduction of LPAI H7N8 by wild waterfowl and environmental conditions that may have or have not supported this introduction.

A. Highlights of this Analysis

The mean high and mean low temperatures for the 6 weeks leading up to the outbreak were warmer than the previous 2 years and were conducive to Influenza A virus survival.

Precipitation in 2016 in the 6 weeks leading up to the outbreak was higher than in 2015, but lower than 2014. However, when paired with generally warmer temperatures, the environment was still likely conducive to support survival of H7N8.

Dubois County is in the same watershed as and downstream from a large reservoir and the Hoosier National Forest, possible sources of LPAI virus introduction into the area.

Presence of cropland in Dubois County did not appear to be a factor that influenced the presence of LPAI H7N8-infected waterfowl relative to other counties.

Dubois County was at the lower range for sources of open water in relation to other counties. Therefore, open water was not considered a factor that may have increased the presence of infected waterfowl in Dubois County compared to other counties.

Dubois County has one of the higher densities of poultry compared to surrounding counties and therefore had a larger susceptible population for introduction of LPAI into commercial poultry.

B. Temperature and Precipitation

Temperature and moisture are factors that influence migration patterns in some waterfowl (Austin et al., 2002). Temperature and moisture for a 6-week period prior to detection in January 2016 were compared to the same period in the previous 2 years. The mean high temperature in 2016 was higher than 2 previous years (Figure 1). The mean high was 50.88 degrees Fahrenheit and the mean low was 34.04 degrees Fahrenheit—above freezing temperatures (Figure 2). These temperatures have been shown to be conducive to persistence of avian influenza virus in the environment. Precipitation in the 2016 period was higher than 2015, but lower than 2014 (Figure 3). However, when paired with temperature information, the moisture in 2016 may have created an environment conducive to H7N8 LPAI survival and the presence of waterfowl.

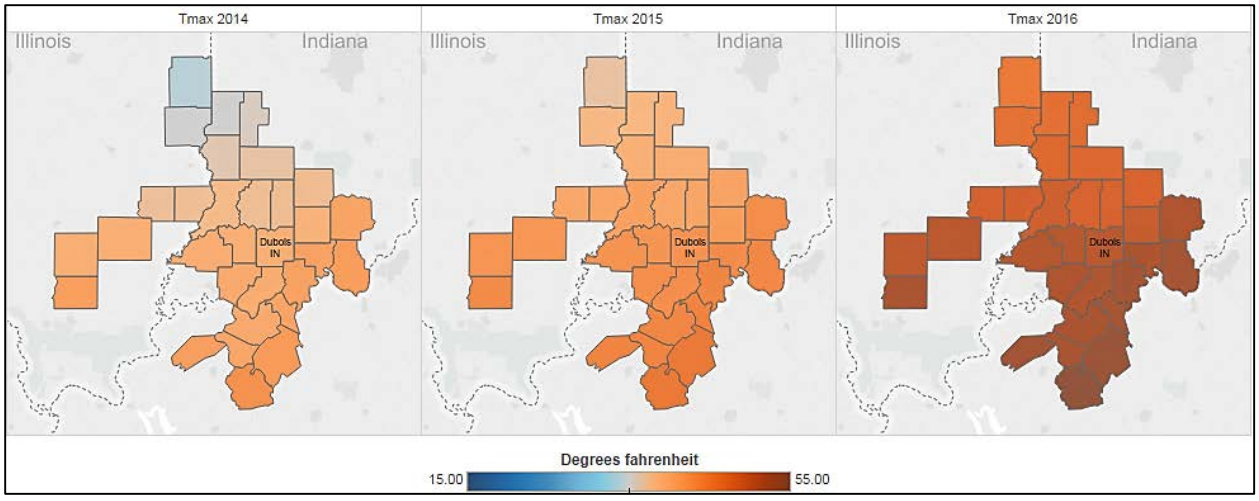

Figure 1. Average daily maximum temperature by year for a 6-week period of December and early January.

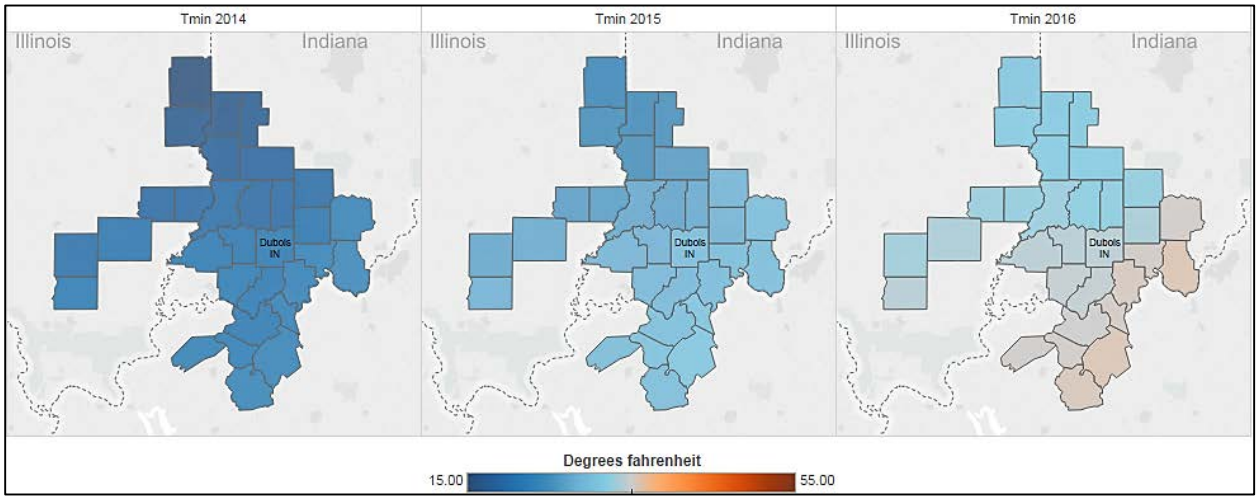

Figure 2. Average daily minimum temperature by year for a 6-week period of December and early January.

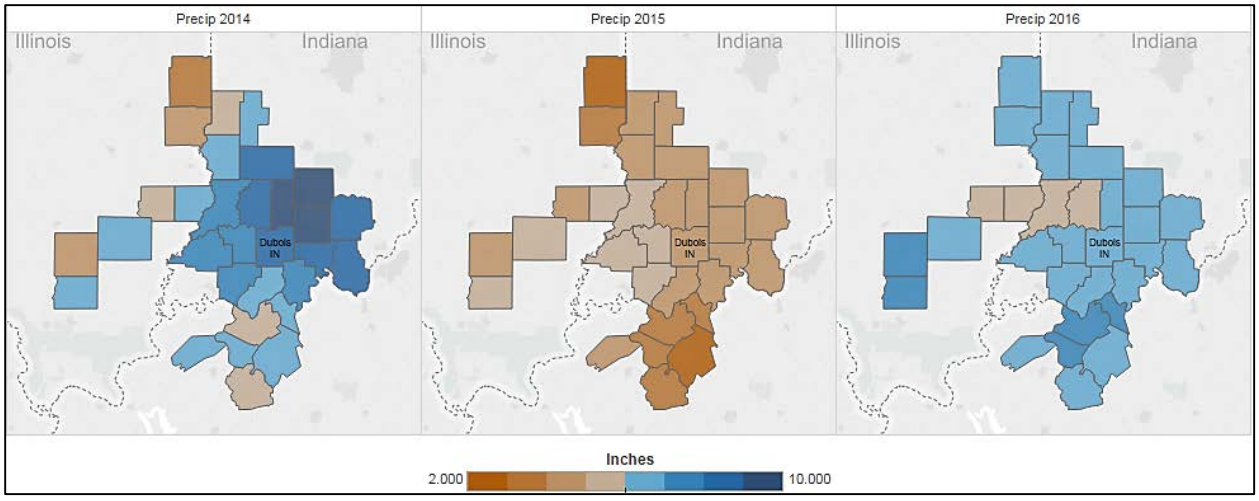

Figure 3. Total precipitation by year for a 6- week period of December and early January.

C. Federal Land and Watershed

Avian influenza viruses have been isolated from water where waterfowl congregate, even after the birds have moved (Ito et al., 1995). Hoosier National Forest is the largest contiguous land area in Indiana that is unaltered by agriculture or urban development (Leatherberry, 2002). Habitats such as Hoosier National Forest create important areas for resting, feeding, or other uses for migratory waterfowl (Kaminski et al., 1989; Leatherberry, 2002). The watersheds that included all 10 affected premises also were hydrologically connected with Hoosier National Forest (Figure 4). Favorable conditions (see Temperature and Precipitation section) within a watershed may attract waterfowl during winter months (Kaminski et al., 1989). If waterfowl were to follow the watershed, or if heavy rains washed feces from infected waterfowl in Hoosier National Forest downstream to Dubois County, these conditions could create an opportunity for introduction into Dubois County that was not shared with other counties in Indiana.

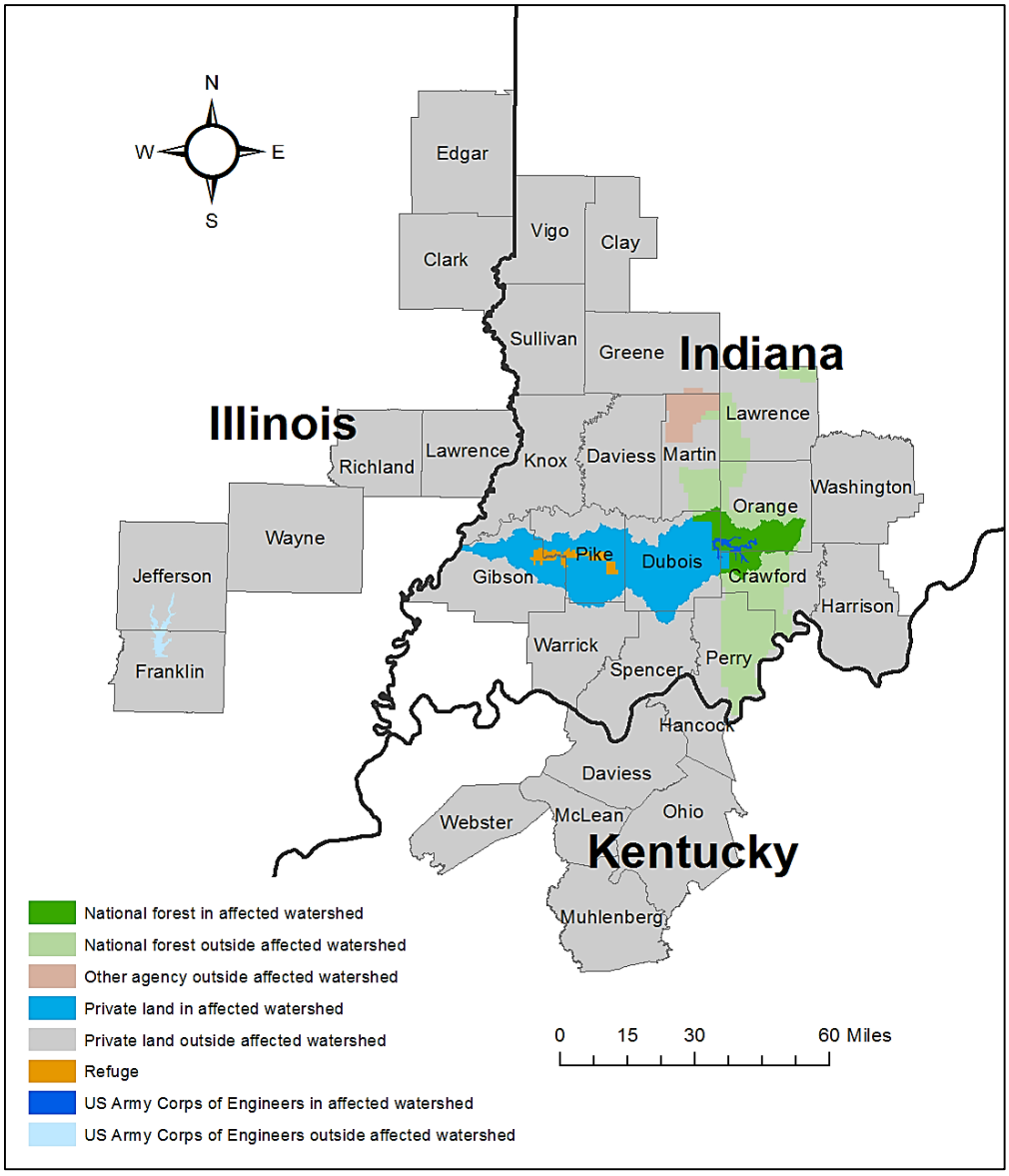

Figure 4. Dubois County is downstream from and within the same watershed as Hoosier National Forest.

D. Other Attributes

An assessment of H5N2 HPAI in Minnesota indicated the presence of cropland may contribute to the presence of infected waterfowl. Cropland is an important component of migratory waterfowl habitat (Kaminski et al., 1989). In Indiana, the counties studied were comprised of between 3.5 and 78 percent cropland. Cropland did not appear to be a factor that influenced the presence of H7N8 LPAI-infected waterfowl in Dubois County relative to other counties (Figure 5). Additional analysis of water usage within crops, the type of crops, and proximity to affected premises may provide additional information.

The percentage of wetland and open water was also explored as possibly important for waterfowl migration (Bellrose and Trudeau, 1987). Dubois County was again in the lower range of the spectrum and these attributes were not considered factors that influence the presence of infected waterfowl in Dubois County relative to neighboring counties (Figure 6 and Figure 7).

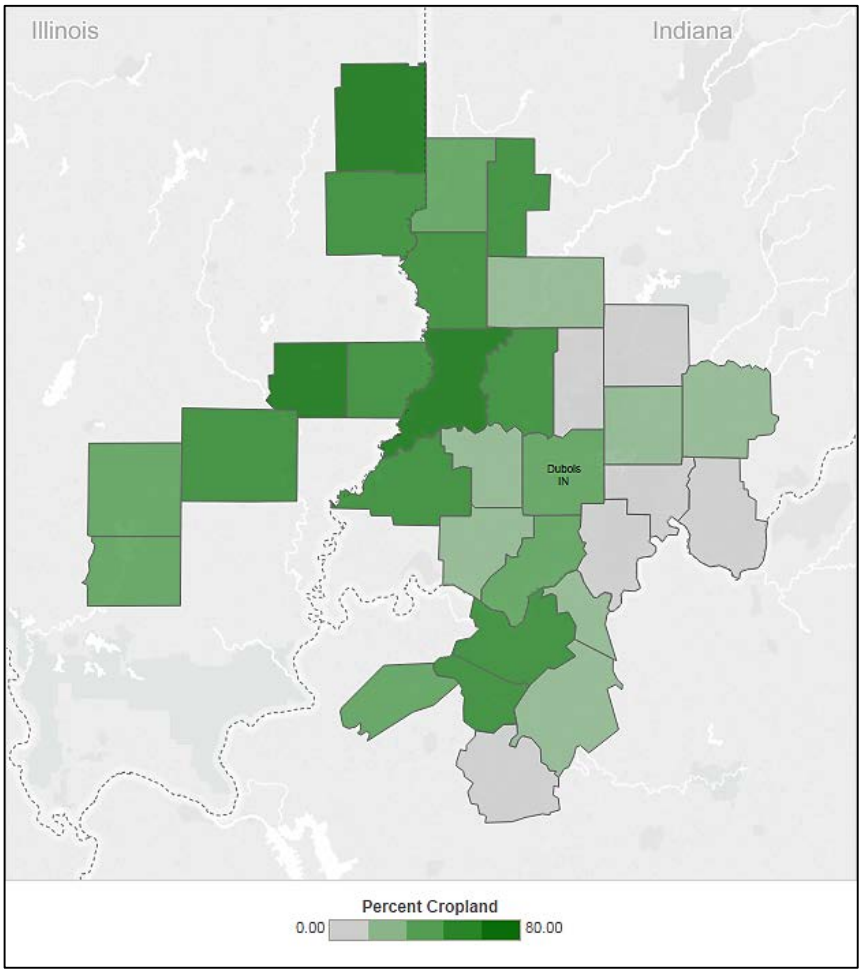

Figure 5. Percentage of county comprised of cropland. 2014 NASS Cropscape.

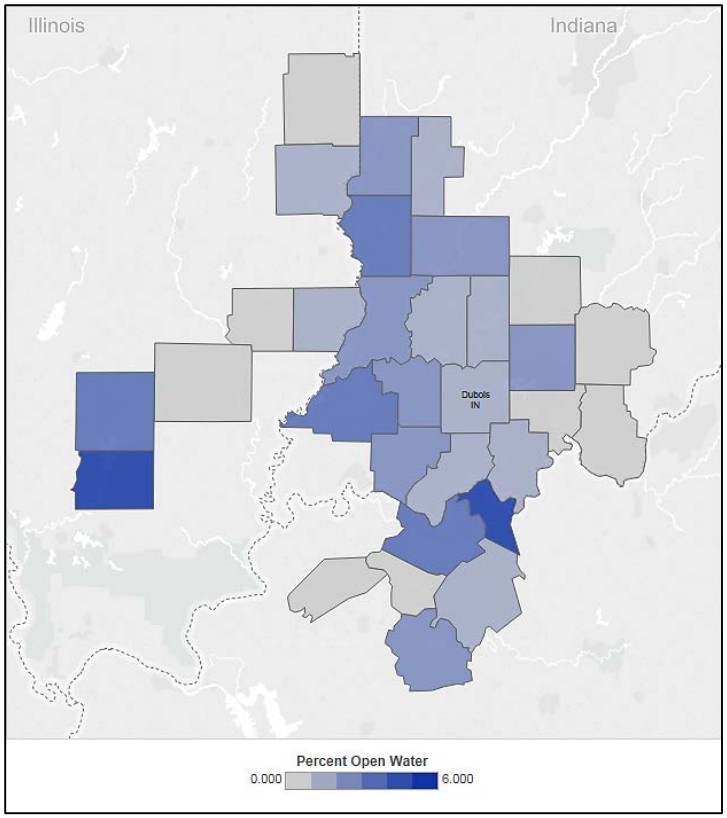

Figure 6. Percentage of county comprised of open water (2014 NASS Cropscape).

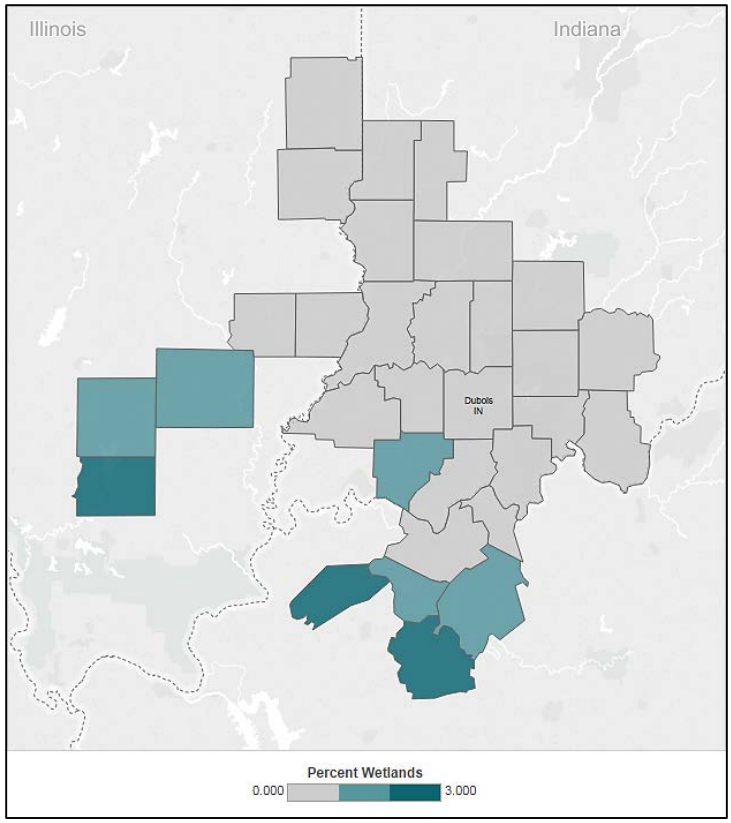

Figure 7. Percentage of county that is comprised of wetland (2014 NASS Cropscape).

E. Population at Risk

For HPAI/LPAI to enter a poultry population, the virus must enter the environment and have a susceptible population to infect. Dubois County has one of the higher densities of poultry compared to its neighboring counties (Figure 8).

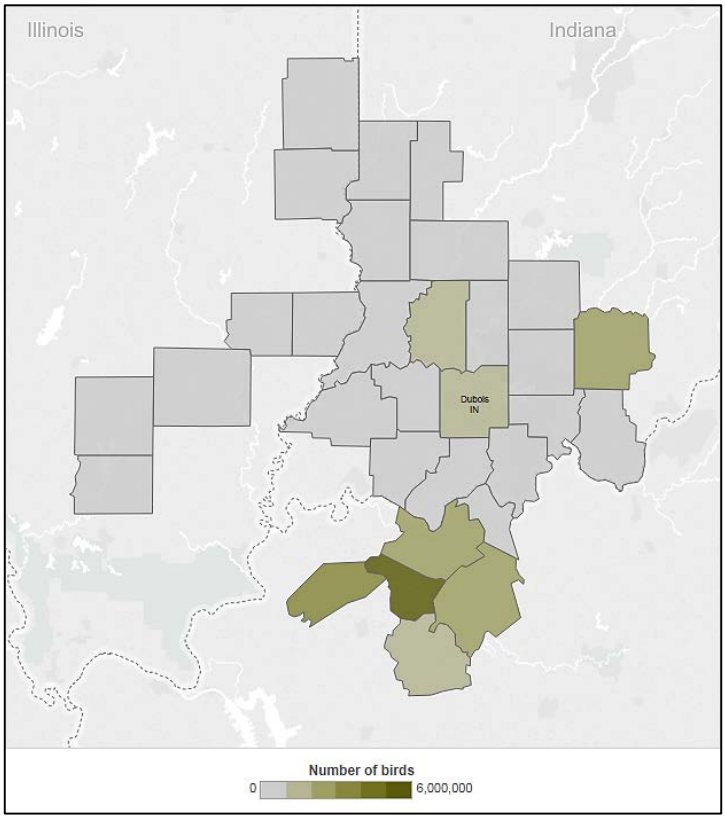

Figure 8. NASS 2012 turkey and chicken inventory of poultry by county.

F. Conclusions

This assessment cannot determine whether H7N8 entered the poultry population by chance, or if waterfowl behavior in early 2016 was normal but management practices influenced the introduction, if wild birds persisted in this area due to conditions, or if other factors led to the introduction of H7N8. However, this assessment describes the large-scale attributes present that may have influenced the introduction and identifies a few hypotheses about these attributes, which could stimulate future studies.

Several environmental factors present in Dubois County appeared to differ from neighboring counties (watershed connectivity, presence of a dense poultry population) or from previous years (higher temperature and precipitation); however, a statistical analysis was not completed at this time. While temperature and precipitation in the counties examined did not appear different, those conditions may have been favorable for migratory waterfowl to remain longer in Indiana. The presence of a large mass of public land with accessible water may also have attracted waterfowl, although this area of Indiana may be where waterfowl normally congregate during migration.

If infected waterfowl were present, Dubois County is downstream and within the same watershed; therefore, birds or their feces may have moved into the county. Neighboring counties downstream did not have the poultry populations to become infected.

Based on this assessment, it is unknown if these factors led to changes in waterfowl presence, if they persisted in Dubois County longer than normal, if infection in the waterfowl led to changes in waterfowl presence, or if the events in Indiana occurred by chance as infected waterfowl happened to pass through this area.

G. Next Steps

Additional analysis of environmental conditions in previous LPAI outbreaks would help determine if the environmental conditions present in Dubois County were a contributing factor to presence of infected waterfowl and subsequent poultry infection.

For future analyses, we are considering questions on elevation of poultry operations and proximity to infected premises and whether these or other geospatial attributes increase the chance of a premises becoming infected.

H. References

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IV. Phylogenetic Analysis and Diagnostics

A. North American H7N8 Viruses

This report describes the H7N8 HPAI virus from a commercial turkey flock in Dubois County, Indiana, confirmed by the National Veterinary Services Laboratories (NVSL) in January 2016.[1] The NVSL confirmed H7N8 HPAI in the index flock by cleavage site analysis from partial hemagglutinin (HA) gene sequence obtained directly from the sample. Eight subsequent H7N8 detections from control zone surveillance were confirmed to be LPAI with high similarity to the HPAI virus excluding the insertion at the cleavage site in the HPAI virus. Due to the potential risk of mutation, control actions appropriate to HPAI were followed. There have been no further detections since January 16.

This is the first detection of an H7N8 HPAI virus. The H7N8 viruses are not related to the Eurasian H5 HPAI viruses from 2014-15. Based upon the full genome sequence[2], the index case of H7N8 HPAI and subsequent detection of H7N8 LPAI are of North American wild bird lineage with high similarity to other recent wild bird viruses (North American Cluster III viruses; blue box in Figure A[3]). They are highly similar to each other across all eight genes (excluding the multi-basic amino acid insertion at the cleavage site responsible for the mutation to HPAI). The H7N8 HPAI and LPAI viruses are also highly similar across six of eight gene segments to a recent wild bird detection of H7N8 LPAI in Kentucky (lesser scaup collected November 28, 2015). This suggests that reassortment, which is common to influenza A viruses in wild birds, occurred prior to the virus being introduced in turkeys in Indiana. However, the mutation to the highly pathogenic form likely occurred during replication of the virus in poultry.

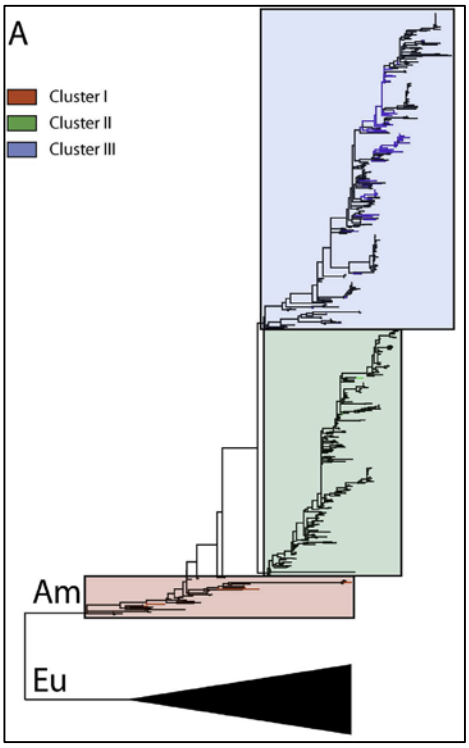

Figure A. Schematic phylogenetic tree of the HA1 nucleotide sequences of H7 AIVs; the tree was constructed on the basis of the phylogeny inferred by using the maximum-likelihood method. Boxes represent the 3 major genetic clusters; the Eurasian lineage (EU) is represented by the large black triangle. Am = North American lineage.

The H7N8 viruses are located in Cluster III.

Courtesy of Xi-Feng Wan et al, Department of Basic Sciences, College of Veterinary Medicine, Mississippi State University

[1] Virus availability announcement: https://www.aphis.usda.gov/animal_health/vet_biologics/publications/notice_16_02.pdf

[2] Genbank IDs: H7N8 HPAI KU558903-8910; H7N8 LPAI KU585905-12 and KU585913-20

[3] Xu Y, Bailey E, Spackman E, et al. 2016. Contemporary H7 Avian-Origin Influenza A Viruses from North America (Scientific Reports, 6: 20688)

In general, influenza A viruses, including H5 and H7 subtypes, circulate in wild waterfowl in a form that is low pathogenic for chickens, and to date H7 HPAI viruses have been documented after the virus has circulated in poultry. The only H5s recognized to circulate in wild birds in a form that is highly pathogenic for chickens are the goose Guangdong-lineage viruses, such as those during the Eurasian H5 clade 2.3.4.4 outbreak in 2014-15. North American H7N8 LPAI virus has been detected previously in wild bird surveillance in the United States, but this is the first instance of H7N8 HPAI virus detection in any species.

All H7N8 viruses detected from this event are of North American wild bird lineage, and the HPAI and LPAI viruses are highly similar across all eight genes excluding the multibasic amino acid insertion at the cleavage site in the HPAI virus.

B. Public Health Aspects

No cases of HPAI H7N8 virus infection have been reported in humans at this time, and no human infections associated with avian influenza A viruses of this particular subtype (i.e., H7N8) have ever been reported.

All viruses to date lack key amino acid substitutions associated with human-like receptor binding or substitutions in the polymerase or other internal genes associated with increased virulence and transmission in mammals.

No known markers of neuraminidase inhibitor (Oseltamivir) resistance have been identified.

Efforts to monitor the health of response workers and on-farm personnel continue.

C. Poultry Vaccine Strain Selection Considerations

Genetic, antigenic, and growth characteristics are considered for selection of poultry candidate strains. Experimental studies in poultry indicate that antibody to the neuraminidase protein does not play a significant role in protection. Antigenic characteristics and challenge studies will be used to evaluate protection of existing and candidate vaccines; ongoing evaluation of viruses for antigenic drift will continue.

D. Diagnostics and Characterization for Influenza A viruses

Molecular diagnostic tests for influenza A virus (IAV) are used across the National Animal Health Laboratory Network (NAHLN) in the United States. As primary surveillance tools, the NAHLN H5 and H7 assays are broadly reactive, and do not distinguish geographic lineage or pathotype. There were no issues with detection of the H7N8 viruses from Indiana using the NAHLN assays. The NVSL uses Sanger sequencing protocols to generate partial HA/NA sequence directly from the sample for confirmation, pathotyping, and subtype determination where sufficient virus is present. Whole genome sequencing is conducted on all isolated viruses and select viruses are further characterized by pathotype assay in specific pathogen-free chickens.

USDA's NVSL collaborates with the Southeast Poultry Research Laboratory (SEPRL), the Influenza Division of the Centers for Disease Control and Prevention (CDC), and other key partners to rapidly share genetic and biological materials. Consensus data from whole genome sequencing is used to monitor the virus evolution and assess risk to veterinary or public health based upon presence/absence of specific amino acid substitutions or protein motifs. Analysis of sequence data includes phylogeny of all eight segments and determination of amino acid substitutions across the HA1 protein.

V. CASE SERIES—TURKEYS

A. Background

In-person interviews were conducted with producers on farms where H7N8 was detected (HPAI (n=1), LPAI (n=9 including 1 that was suspect by PCR but virus isolation was negative). The questionnaire addressed general premises characteristics, biosecurity practices, wild birds, employees and visitors, vehicles and equipment, litter handling, and dead bird disposal. In addition, questions were asked about one infected barn. Data were entered into a SAS data set. The purpose of this analysis was to identify commonalities among the infected farms that may provide insights about how the virus was introduced and spread. The number of AI-positive farms having farm-level (table 1) and barn-level (table 2) characteristics for selected variables are reported here. Results for the complete set of variables are included in the appendix.

All infected farms were raising grower turkey toms; four farms also raised brooder birds, maintained in different barns from the growers. Seven farms had single-age birds and three had multiple-age birds. All 10 farms reported a pond located within 350 yards of the farm. Seven farms reported that a crop field was located within 50 yards of the farm. Nine farms reported a gravel road that vehicles drive on to enter the operation. The presence of a gravel road was identified as a risk factor in the turkey case-control study associated with the 2015 HPAI outbreak in Minnesota. Feed trucks and company personnel vehicles approached the barns, but renderer and garbage trucks did not. The case-control layer study in the 2015 Iowa outbreak found renderer and garbage vehicles approaching the barn to be a risk factor.

None of the AI-positive farms used different personnel in different barns; three required employees to scrub footwear, and only one required employees to stay off-farm at least 24 hours after exposure to other poultry. Visitors were not required to avoid visiting multiple farms on the same day. All 10 farms shared company trucks and feed trucks during the 14 days prior to infection. Eight farms reported that a company service person visited and entered a barn in the 14 days prior to infection; on 7 farms, the company service person entered the infected barn. The previous layer study found an association between company service personnel visits and infection status.

Waterfowl and other birds were rarely observed on the farm or in nearby fields or water bodies during the 14 days prior to infection (see appendix).

Information regarding one infected barn was collected for each farm. All birds in infected barns were over 8 weeks of age; birds in 7 barns were 14 or more weeks of age. All barns contained grower toms. In the previous layer study, cleaning and disinfecting the barn's hard surface entry way was associated with decreased odds of being infected. Only three farms reported doing so here.

B. Next Steps

Approximately 30 control farms from the control zone will have the case control questionnaire implemented in the near future. Control farm results from the questionnaire will be compared to these results from the cases.

A geospatial analysis will be conducted to examine potential environmental factors associated with infection status.

Table 1. Farm-level characteristics

Characteristic	Number of farms	
Stage of production:		
Brooder	4	
Grower	10	
Breeder	0	
Other	0	
Sex:		
Hens	0	
Toms	10	
Age of birds on farm:		
Multiple	3	
Single	7	
Water body within 350 yards:		
Pond	10	
River	1	
Other	0	
Road surface:		
Gravel	9	
Other	1 (gravel and asphalt)	
Vehicles come near barns:		
Garbage	1	
Propane delivery	2	
Feed delivery	10	
Renderer	0	
Company personnel	9	
Other business visitors	6	
Requirements *(always)* for workers entering the barns during the 14-day risk period:		
Establish clean/dirty line	9	
Shower	1	
Wash hands/hand sanitizer	3 plus 2 sometimes	
Different personnel for different barns	0	
Disposable coveralls	2	
Change clothing	5	
Change shoes/shoe covers	9	
Liquid foot bath	8	
Dry foot bath	1	
Scrub footwear	3	
Workers on the farm:		
Work on other company farms	4	
Employed by other poultry operations	1	
Own their own poultry	0	
Required to stay off farm at least 24 h after exposure to other poultry	1	
Visitors not visit multiple farms on same day	0	
Visitor during the 14-day risk period:	Visited	Entered barn
Company service person	8	8
Feed delivery personnel	8	1
Shared vehicles:		
Company trucks	10	
Feed trucks	10	

Table 2. Barn-level characteristics (respondents answered for one infected barn per farm)

Characteristic	Number of barns
Type of poultry present in barn:	
Brooder	0
Grower toms	10
Grower hens	0
Breeders	0
Other	0
Age of birds (weeks):	
Less than 8	0
8 to less than 14	2
14 or more	7
Footbaths in use at this barn:	
Dry	1
Liquid	9
People who entered the barn during the 14-day risk period:	
Private or company veterinarian	2
Company service person	7
Occasional worker	3
Hard surface entry pad:	
Cleaned and disinfected	3
Cleaned only	1
Not cleaned or disinfected	4
No hard-surface entry pad	2

VI. On-Farm Sampling: Preliminary Report

A. Sampling for Influenza A Virus in Synanthropic Wildlife at Infected Premises

Objective

To evaluate the potential for synanthropic wildlife associated with commercial turkey flocks to become exposed or infected with highly pathogenic or low pathogenic influenza A (H7N8) viruses, we sampled peri-domestic birds and mammals on farms that had been infected with H7N8.

Four farms with confirmed H7N8 infections were investigated (Table 1). All flocks were located in southern Indiana. Sampling at confirmed infected sites was conducted within 2 weeks after viral excretion was confirmed in poultry. Three of the four infected flocks were depopulated prior to wildlife sampling and one of the flocks was being depopulated during sampling.

Table 1. Summary of Infected Flocks

Site	Approximate Flock Size	Virus	Date H7N8 Confirmed by NVSL	Wildlife Sampling Period
DuBois8	36,695	Low Pathogenic	1/16/2016	1/20-23/2016
DuBois1	62,109	Highly Pathogenic	1/14/2016	1/25-27/2016
DuBois9	16,591	Low Pathogenic	1/16/2016	1/28-29/2016
DuBois6	24,732	Low Pathogenic	1/16/2016	1/30/2016

Sampling Procedures

Wild birds and wild mammals were captured on farms, primarily around farm structures. Birds were captured using mist nets and baited funnel traps. Mammals were trapped using baited collapsible Sherman traps (mice) and baited Tomahawk traps. We also collected environmental samples in and around feed hoppers and barns.

Captured individuals were sampled for testing infection with influenza A viruses (IAV) by collecting swabs, washes, and tissues. Prior exposures were also investigated by testing serum. From birds, we collected an oral swab and a cloacal swab. From targeted avian species (e.g., European starlings), we also collected a blood sample and lung tissue. From mammals, an oral swab, nasal swab/wash, and external swab were collected. From targeted species, a blood sample and lung tissue sample were also collected. Swabs, washes, and tissue samples were placed in 1-3mL of viral transport media and stored chilled. Blood was collected into serum separator tubes, allowed to clot, and centrifuged. We shipped samples overnight on ice to testing laboratories within 24 hours during the week or stored them in a refrigerator and then shipped overnight on ice.

Laboratory Procedures

Swabs, washes, and tissue samples will be screened for influenza A virus (IAV) matrix gene RNA via real-time reverse transcriptase polymerase chain reaction (RRT-PCR). The Avian Veterinary Diagnostic Laboratory at Colorado State University is conducting matrix gene RRT-PCR testing of avian oral and cloacal swabs, while the National Wildlife Research Center Virology Laboratory will conduct all other matrix gene RRT-PCR. Per the National Animal Health Laboratory Network (NAHLN) protocol, any cycle threshold (Ct) value >0 is considered positive for viral RNA. Samples with Ct>0 by matrix gene RRT-PCR will submitted to the USDA's NVSL in Ames, IA, for confirmatory testing. Confirmatory testing will include subtype confirmation using H5 and H7 assays targeting

American lineage viruses. If PCR positive samples are detected, virus isolation in embryonated chicken eggs will be conducted in parallel. All serum samples will be screened for antibodies to influenza A using the IDEXX AI Multi-S Screen Ab test, which is a multi-species blocking enzyme linked immunosorbent assay (ELISA) targeting an epitope of the nucleoprotein. All serum samples with S/N ratios <0.7 will be submitted to NVSL for hemagglutinin inhibition (HI) assay testing using the H7N8 virus as the antigen.

Results

Across the 4 sampled farms, we collected 297 samples from 81 individuals (primarily starlings, (Table 2). We sampled 77 individual birds across 4 species and 4 individual mammals across 3 species (Table 3). European starlings were the most commonly sampled species. We also collected 40 environmental samples, of which all but four were presumed to be from European starlings.

PCR testing for 71 of 77 oral and cloacal swabs are complete and all samples were negative. PCR testing of all environmental samples is complete and all samples were negative. ELISA testing for 64 of 65 serum samples has been completed. No samples were positive for antibodies to influenza A virus, but three samples were suspect positive and will be submitted to NVSL for HI testing (Table 4).

Table 2. Summary of Samples Collected

Sample Type	Total Number Collected	Number Collected from Birds	Number Collected from Mammals
Serum	65	62	2
Oral Swab	81	77	4
Cloacal Swab	77	77	--
Nasal Swab/Wash	4	--	4
External Swab	2	--	2
Lung Tissue	67	63	3
Environmental	40	38	2

Table 3. Summary of Animals Sampled

Species	Scientific Name	Numbered Sampled
House mouse	*Mus musculus*	2
White-tailed deer	*Odocoileus virginianus*	1
Raccoon	*Procyon lotor*	1
European starling	*Sturnus vulgaris*	63
Dark-eyed junco	*Junco hyemalis*	8
White-throated sparrow	*Zonotrichia albicollis*	4
Song sparrow	*Melospiza melodia*	2

Table 4. Summary of positive samples for avian serum samples tested by ELISA

Sample	Species	ELISA	S/N Ratio
IDa01020	European starling	Suspect Positive	0.66
IDa01026	European starling	Suspect Positive	0.68
Ida01027	European starling	Suspect Positive	0.61

Summary

To date, no wildlife samples from animals associated with infected premises that have been tested showed evidence of influenza infection. However, several important observations were noted among the sampled farms. First, the high levels of ammonia associated with depopulation and composting likely lowered mouse populations associated with turkey barns and undoubtedly influenced the number of mice captured. Second, weather patterns appeared to influence bird capture success, as the bulk of the starlings sampled in this survey were captured when temperatures were unseasonably low and snow was on the ground. Capture success was greatly reduced at subsequent farms (when snow was largely absent). Third, spilled feed from grain hoppers appeared to be a key factor attracting wildlife to the single farm that had multiple feed spills due to feed hopper tubing breaches. Fourth, forest birds made up the majority of wildlife observed in proximity to the farms and they did not come near the barns. Fifth, relatively low numbers of wildlife captures were expected during the winter months due to altered ecology during that season resulting in differing resource use of farms (wildlife farm visits may be sporadic, especially for birds), annual mortality (many animal populations are lowest during the winter), reduced resources, lack of breeding, and minimal movements.

This effort highlights the need to survey multiple poultry facilities in several regions of the United States to assess wildlife interactions with poultry facilities. Similar studies in Canada have been used for risk assessments and to develop lists of key species of concern. A comparable approach in the United States could develop lists of key wildlife species of concern to the poultry industry. Once developed, the species list could be used to guide experimental infection studies to assess the reservoir competence of select synanthropic wildlife species.

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VII. Literature Review

A. Latent and Infectious Periods for H7 HPAI Virus Strains

Background

The following is a brief summary of the latent and infectious period data for chickens and turkeys from literature review as well as unpublished data shared by the Southeast Poultry Research Laboratory in Athens, GA. The statistical distributions estimated from these data are useful for disease spread modelling and for evaluating the impact of various surveillance and movement protocols. Many of the analyses conducted to support emergency response and business continuity measures have been based on the latent and infectious periods for H5 HPAI viruses. The purpose of this review was to evaluate whether the latent and infectious periods for chickens and turkeys infected with H7 HPAI viruses differed greatly from what has been seen with H5 HPAI viruses.

Bird-level infectious period and mean time to death for H7 HPAI

There is considerable variability in the estimated infectious period for different H7 HPAI strains. The mean infectious period estimate was 6.3 days for Netherlands HPAI H7N7 in chickens (Table 1). Given the available data, only the mean time to death could be estimated for the Jalisco HPAI H7N3 strain. The mean time to death in chickens for this strain was around 2.3 days and suggests a shorter infectious period compared to the Netherlands strain.

In turkeys, the estimated infectious period was 6.2 days for the Netherlands HPAI H7N7 strain and 1.47 days for the Italy HPAI H7N1 strain. The mean time to death for the Mexico HPAI H7N3 strain in turkeys was 2.47 days.

Bird-level latently infected period

The estimated mean latent period in turkeys was 0.8 days for Netherlands HPAI H7N7 and 0.4 days for Italy HPAI H7N1 strain.

For chickens, the available experimental data was censored with testing for shedding at daily intervals. However, for both the Mexico HPAI H7N3 strain and Netherlands HPAI H7N1 strains, the inoculated chicken were shedding by the first day indicating a short latent period.

Table 1. Summary of infectious period and time to death data for H7 HPAI strains

HPAI strain	Source	Species	Parameter estimated	Estimated value / Distribution Days
HPAI H7N3 Mexico	Unpublished data (Erica Spackman)	Turkeys	Time to death	2.47 days (95% C.I., 0.9-4.92). Gamma (5.96,0.41)
HPAI H7N3 Mexico	Unpublished data. Kapczynski (personal communication)	Chickens	Time to death	1.9 (95% C.I., 0.9-4.92), Gamma (10.7,.18)
HPAI H7N3 Mexico	Bertran 2013; Kapczynski et al 2013; Spackman et al 2014. [1-3]	Chickens	Time to death	2.25; 2.3
HPAI H7N7 Netherlands	Vandergoot et al 2005 [4]	Chickens	Infectious period	6.3(95% C.I., 3.9-8.7)
HPAI H7N7 Netherlands	Bos et al 2008 [5]	Turkeys	Infectious period	6.2 days (range 5-8)
HPAI H7N7 Netherlands	White paper- Templeton et al, Maas et al 2009 [6]	Chicken	Time to death	5.1 (95% C.I. 3.5-6.9);

HPAI strain	Source	Species	Parameter estimated	Estimated value / Distribution Days
HPAI H7N7 Netherlands	CEAH analysis [4, 6]	Chicken	Infectious period	4.1 (95% C.I. 2.3-5.6); Gamma (5.738, 5.445)
HPAI H7N1 Italy	Saenz et al 2012 [7]	Turkeys	Infectious period	1.47 (95% C.I., .3-3); Gamma (2.199,1.668)

Table 2. Summary of bird-level latent period data for H7 HPAI strains

HPAI strain	Source	Species
HPAI H7N3 Mexico	Kapczynski et al (personal communication)	Between 0-1 days: 5 chickens inoculated, all were shedding within 24 hours;
HPAI H7N7 Netherlands	Vandergoot et al 2005 [4]	Between 0-1 days: 10 chickens inoculated, all were shedding within 24 hours;
HPAI H7N7 Netherlands	Bos et al 2008 [5]	0.7 days: 8/10 turkeys were shedding by 1 day and 2/10 turkeys by 2 days. Gamma (17.08, 0.04)
HPAI H7N1 Italy	Saenz et al., 2012 [7]	Mean 0.40 days: based on 10 inoculated turkeys. Suggested gamma distribution (Gamma 2.2,0.186)

Summary and implications for current outbreak

The infectious and latent period distribution data was summarized for three H7 HPAI strains. Overall, the infectious period was short (1.5-2.5 days) for HPAI H7N3 and HPAI H7N1 strains compared to Netherlands HPAI H7N7 strain, which had an infectious period around 6 days. The data indicate a short latent period (less than 1 day) for all the three strains summarized. These results are similar to the infectious and latent period distributions identified during the 2015 outbreak of HPAI in the United States.

These results suggest that the assumptions related to bird-level viral transmission dynamics used for modeling work and analysis based on the U.S. HPAI outbreak in 2015 are still appropriate for an outbreak involving a highly pathogenic H7 virus.

B. Predominant Clinical Signs in turkeys for Recent Outbreaks of H5 or H7 HPAI virus strains

Background

The presence and severity of clinical signs of HPAI infection depend on the type of bird species affected. Infected wild and domestic ducks may be asymptomatic, whereas clinical signs in gallinaceous poultry are usually severe, resulting in high mortality. In poultry (chickens and turkeys), the clinical signs associated with HPAI infection include marked depression with ruffled feathers, lack of appetite, excessive thirst, decreased egg production, soft-shelled or misshaped eggs, respiratory signs (coughing and sneezing), watery diarrhea, or sudden, unexpected death. In turkeys, a cessation in flock vocalization (Cathedral Syndrome) often accompanies infection. Mature chickens frequently have swollen, cyanotic combs and wattles and edema surrounding the eyes.

The mortality rate in an infected flock can reach 100 percent. In mature birds, gross lesions on necropsy may consist of subcutaneous edema of the head and neck; fluid in the nares, oral cavity, and trachea; congested conjunctivae and kidneys; and petechial hemorrhages that cover the abdominal fat, serosal surfaces, peritoneum, and surface under the keel. In layers, the ovary may be hemorrhagic or degenerated and necrotic. The peritoneal cavity is frequently filled with yolk from

ruptured ova, causing severe airsacculitis and peritonitis in birds that survive longer than 7 days. In addition, necropsy of birds affected in the 1999–2001 H7N1 HPAI outbreak in Italy revealed pancreatitis in all species of birds; this was most pronounced in turkeys and chickens.[8]

Clinical signs in turkeys

Clinical signs for HPAI infection in turkeys are different from those in chickens. Moreover, they vary depending on the HPAI virus strain (see Table 3). Respiratory signs may not be present in turkeys infected with HPAI, and producers should watch for other symptoms including neurological signs.

Table 3. Summary of primary clinical signs seen in turkeys during recent outbreaks by HPAI strain

HPAI Strain	Clinical signs	Source
H7N1	Nervous signs	Mutinelli et al., 2003 [8]
H5N8	Depression, loss of balance, drooping of wings, twitching	McNulty et al., 1985 [9]
H7N7	Apathy, reduced vocalization, swollen sinuses, mucus from beak, lying down with neck extended	Elbers et al., 2004 [10]
H5N1	Attenuated motor functions, torticollis and nystagmus, general behavioral aberrations	Perkins and Swayne, 2001 [11]
H5N1	Reluctance to move, facial oedema, sinusitis, oculo-nasal discharge, and haemorrhages on the shanks	Kilany et al., 2011 [12]
H5N1	Depressed, quiet flock, nearly all sitting down, apathy, fine head tremors	Irvine et al., 2007 [13]
H5N9	Depressed, wings dropped, diarrhea, abnormal respiration was not seen, listless	Narayan, Lang and Rouse 1969 [14]
H5N2	Lethargy, depressed, lack of vocalization neurological signs, occasional torticollis and blood from the mouth	2015 US Outbreak Reports

C. References

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APPENDIX A. FARM-LEVEL QUESTIONS

Number of AI Positive Farms by Farm Characteristics	
Characteristic	**Number of farms**
Farm size (number of birds on farm on reference date):	
Less than 20,000	4
20,000 to 49,999	6
50,000 or more	0
Number of barns on the farm:	
1	1
2	0
3 to 5	7
6 or more	2
Number of barns confirmed AI positive:	
1	5
2	1
3 or more	2
Marketing arrangement:	
Contract	10
Other	0
Stage of production:	
Brooder	4
Grower	10
Breeders	0
Other	0
If both grower and brooder:	
In barn at same time	0
In same barn but at different times (e.g., placed as brooders and remain through grow-out)	0
In different barns	4
Birds have outside access	0
Sex of market type:	0
Hens (HH or LH)	0
Toms (FP)	10
Age of birds on farm:	
Multiple	3
Single	7
Other poultry on farm (e.g., broilers, layers, etc.)	0
Certified Organic	0
Enrolled in NPIP	10
Water bodies within 350 yards:	
Pond	10
Lake	0
Stream	0

Number of AI Positive Farms by Farm Characteristics	
Characteristic	**Number of farms**
River	1
Wetland or swamp	0
Wastewater lagoon	0
Other	0
Waterfowl seen on the above water bodies during the 14-day defined risk period:	
Ducks	1
Geese	0
Shorebirds	2
Other	0
Distance (yd) to the closest field where crops or hay are harvested:	
Less than 50	7
50 to 99	2
100 or more	1
Crop grown in the above field:	
Corn	6
Soybeans	2
Alfalfa/grass	2
Other	0
Above field tilled last fall	3
Above field actively worked during the 14-day defined risk period:	0
Waterfowl seen on the field during the 14-day defined risk period:	1
Other animals present on farm premises:	
Beef cattle	4
Dairy cattle	0
Horses	0
Sheep	0
Goats	0
Pigs	0
Dogs	3
Cats	5
Poultry or domestic waterfowl (noncommercial)	0
Other	0
Water source for poultry:	
Municipal	9
Well	1
Surface	1
Other	0
Water treatments:	
Chlorination (excluding municipal)	0
Acidifiers	0
Iodine	1
Peroxide	1

Number of AI Positive Farms by Farm Characteristics				
Characteristic	**Number of farms**			
Other	0			
Windbreaks present on farm and average distance (yd):	**# farms**	**Avg. distance**		
Evergreen or juniper	0			
Deciduous trees	5	25 (5–50)		
Structural (e.g., hill, natural break)	1	200		
Distance to nearest public gravel or dirt road, excluding driveways:				
Less than 100 yd	2			
100 to 300 yd	3			
0.5 to 1 mi	5			
Direction from public road to farm:				
East	4			
Northeast	1			
South	3			
West	2			
Number of farms by biosecurity practices				
House with people living in it on the property	5			
If yes, common drive entrance to farm and residence	5			
More than one entrance to the farm that could provide access to the poultry area	1			
Road surface on the farm that vehicles coming onto the operation drive on:				
Hard top/asphalt	0			
Gravel	9			
Dirt	0			
Other	1			
Access of the following vehicles:	**Perimeter only**	**Enter farm/not near barn**	**Near barn**	**Does not come**
Garbage/dumpster pickup	1	0	1	8
Propane delivery	1	1	2	6
Feed delivery	0	0	10	0
Renderer	0	0	0	10
Company personnel	1	0	9	0
Other business visitors	2	1	6	1
Has gate to farm entrance	0			
Perimeter surrounded by security fence	0			
Vegetation mowed/bush hogged at least 3 times per month	9			
Vehicle wash station/spray area used during the 14-day defined risk period	0			
Workers and visitors park in restricted area away from the poultry barns during the 14-day defined risk period:	**Always**	**Sometimes**	**Never**	
Workers	8	2	0	
Visitors	4	3	3	
Rat/mouse bait stations used on the farm during the 14-day defined risk period	9			
If yes, frequency checked (times/month):				
Less often than 1	2			

Number of AI Positive Farms by Farm Characteristics			
Characteristic	**Number of farms**		
1	5		
2	1		
3 or more	0		
Frequency rodents observed during the 14-day defined risk period:			
Frequently (e.g., daily)	2		
Occasionally (e.g., weekly)	1		
Never	6		
Beetle control used during the 14-day defined risk period:			
Sprays	1		
Boric acid	2		
Baits	0		
Other	0		
Any	2		
Intensity of beetles observed in poultry barns during the 14-day defined risk period:			
High	0		
Medium	1		
Low	3		
Never	5		
Fly control (other than manure removal) used during the 14-day defined risk period	0		
Intensity of flies observed in poultry barns during the 14-day defined risk period:			
High	0		
Medium	0		
Low/none	9		
Wild mammals (or evidence) observed in or around poultry barns during the 14-day defined risk period	7		
Access to poultry feed:			
Wild birds	3		
Wild animals	3		
Rodents	2		
Pelleted feed	10		
Feed treatment:			
Formaldehyde	0		
Heat treated	9		
Number of farms by wild birds observed during the 14-day defined risk period			
Within 100 yards of barns:	**Often**	**Sometimes**	**Never**
Waterfowl	0	3	6
Gulls	1	0	9
Small perching birds	3	4	2
Blackbirds/crows	2	4	3
Other water birds	0	1	8
Wild turkeys, pheasants, quail	1	2	6
Raptors	0	3	6
Pigeons/doves	0	0	9

Number of AI Positive Farms by Farm Characteristics			
Characteristic	**Number of farms**		
Other	0	0	8
In the barn:			
Large birds (pigeons, crows)	0	0	0
Small birds (finches, sparrows, starlings)	0	0	9
Other	0	0	9
Dead birds:			
Inside the barn		0	
Outside the barn		0	
Number of farms by farm help/workers			
Number of employees:			
1		4	
2		2	
3 or more		3	
Frequency measures were required for workers entering the barns during the 14-day risk period:	**Always**	**Sometimes**	**Never**
Establish clean/dirty line	9	0	0
Shower	1	0	8
Wash hands/hand sanitizer	3	2	4
Different personnel for different barns	0	0	9
Disposable coveralls	2	0	7
Change clothing	5	0	4
Change shoes/shoe covers	9	0	0
Liquid foot bath	8	0	1
Dry foot bath	1	0	8
Scrub footwear	3	1	5
Workers on the farm:			
Work on other company farms		4	
Employed by other poultry operations		1	
Own their own poultry		0	
Required to stay off farm at least 24 h after exposure to other poultry		1	
Number of farms by farm visitor policies			
Visitor log used		6	
Visitor type during the 14-day risk period:	**Visitors**	**Avg # times**	**Entered barn**
Federal/State veterinary or animal health worker	0		
Extension agent or university veterinarian	1		
Private or company veterinarian	1	2 (1-3)	2
Company service person	8	2 (1-5)	8
Nutritionist or feed company consultant	0		
Bird delivery personnel	0		
Vaccination crew	0		
Catch crew (bird removal)	2	1	1
Feed delivery personnel	8	7 (1-17)	1

Number of AI Positive Farms by Farm Characteristics			
Characteristic	**Number of farms**		
Egg truck personnel (for breeder farms)	0		
Litter delivery services	1	1	0
Litter removal services (e.g., litter broker, litter disposal)	0		
Customer (private individual)	0		
Wholesaler, buyer, or dealer	0		
Renderer	0		
Occasional worker (e.g., family member, part-time help over holiday)	4	8 (1-14)	3
Construction workers, repair or maintenance person	0		
Other business visitors (including other producers, meter readers, package delivery (UPS), etc.)	3	1	1
Other nonbusiness visitors (including neighbors, friends, family members, and school field trips)	1	14	0
Requirements for visitors who entered the barn during the 14-day risk period:	**Yes; verified at farm**	**Yes; visitor responsibility**	**No**
Change clothing	7	2	0
Foot covers or change footwear	7	2	0
Mask	3	0	6
Hand sanitizer or gloves	7	2	0
Not visit multiple farms in the same day	0	0	9
Other	0	0	9
Number of farms by farm vehicles and equipment			
Shared the following vehicles with another farm during the 14-day defined risk period:	Number of farms		
Company trucks/trailers (e.g., pickup truck, trailer with supplies, supervisor truck)	10		
Feed trucks	10		
Bird delivery (i.e., placing birds)	0		
Bird removal	1		
Egg removal (for breeder farms)	0		
Manure/litter hauling	0		
ATV/4-wheeler	2		
Other	0		
Equipment	1 (live haul loader)		
Number of farms by litter handling			
Litter heat treated	3		
Litter storage:			
Outside	0		
Closed shed	3		
Open shed	4		
Stored less than 30 yards from barn	3		
Stored litter accessible to:			
Wild birds	4		
Wild animals	4		
Domestic animals	4		

Number of AI Positive Farms by Farm Characteristics	
Characteristic	**Number of farms**
Litter disposal method:	
Composted on-farm	3
Stored on-farm	2
Applied to land on farm	2
Taken off-site	9
Manure or used litter from other farms spread on this farm	0
Number of farms by dead bird disposal	
Normal daily mortality (%):	
Less than 0.2	9
0.2 or more	0
Dead bird (daily mortality) disposal method:	
Composting	7
Burial	0
Incineration	1
Rendering	0
Landfill	0
Other off-farm	2
If compost or burial, cover with:	
Soil	1
Manure	6
Wild birds or wild mammals observed around the dead bird collection area during the 14-day risk period:	
Wild birds	5
Wild mammals	4
Common (off-farm) collection point for dead bird disposal	3

APPENDIX B. BARN-LEVEL QUESTIONS

Number of barns by barn characteristics	
Characteristic	**Number of barns**
More than one barn (flocks) in the barn structure:	0
Type(s) of poultry are present in this barn:	
Brooder	0
Grower toms	10
Grower hens	0
Breeders	0
Other	0
Birds in this barn have outside access	1
Number of birds placed in this barn:	
Fewer than 4,000	0
4,000 to 9,999	10
10,000 or more	0
Length of time birds in barn (weeks):	
Less than 4	0
4 to less than 8	2
8 to less than 12	2
12 or more	5
Age of birds (weeks):	
Less than 8	0
8 to less than 14	2
14 or more	7
Different stages of production (e.g., brooders and growers) present in this barn at the same time	1
Another health concern in this flock during the defined risk period	4
Flock being treated for a condition or health concern during the defined risk period	4
Age of barn structure (yr):	
Less than 5	0
5 to less than 10	1
10 or more	9
For barns more than 5 years old, last remodeled within 5 years	6
How well the barn structure has been maintained:	
1. Well (e.g., walls, curtains, and mud boards do not have holes, no visible daylight, the barn is tight and well insulated)	7
2. Moderate (e.g., barn could have rust or small holes, mud boards may be damaged, curtains may be torn or not in good repair, curtains may not close all the way, insulation may not be in good repair, the poly may be hanging from the ceiling)	3
3. Poor (e.g., holes in walls and mud boards are apparent, tin is rusted, may have leaks in roof, there might be some holes large enough for wild birds to enter, multiple areas with daylight visible, insulation may be hanging from the ceiling)	0

Number of barns by barn characteristics			
Characteristic	**Number of barns**		
Type of ventilation used for this barn during the 14-day defined risk period:			
Curtain ventilated	3		
Environmental control/tunnel ventilation	6		
Side doors (i.e., tip outs)	1		
Other	0		
Intake air filtered	0		
Needed to repair or replace any feed tank lids in the past 14 days	0		
Any feed tank lids open in the past 14 days	0		
Ground surface immediately surrounding (within 1 yard) this barn (excluding vehicle approach and loading area):			
Gravel or hard surface	6		
Dirt	0		
Short grass	4		
Tall grass or brush	0		
Hard-surface entry pad (e.g., concrete, asphalt):			
Cleaned and disinfected	3		
Cleaned only	1		
Not cleaned or disinfected	4		
No hard-surface entry pad	2		
Frequency the following were used in this barn during the 14-day defined risk period:	**Used regularly**	**Not used regularly**	**Not available**
Locks on the doors	1	5	4
A service room that personnel must enter through that separates “outside area” from “inside area”	10	0	0
Changing area for employees	9	0	1
A shower for employees	1	0	9
Cool cell pads	0	3 not used in winter	7
Misters	0	9 not used in winter	1
Type of footbath is in use at this barn:			
Dry (i.e., powdered or particulate)	1		
Liquid	9		
Other	0		
None	0		
Dry footbath changed at least 1x/week	1		
Liquid footbath changed at least 1x/day	0		
Type of litter used in this barn:			
Wood shavings	9		
Hulls (e.g., oat, rice, sunflower, other)	1		
Straw	0		
Other	0		
Litter is:			

Number of barns by barn characteristics	
Characteristic	**Number of barns**
Bagged (i.e., bailed)	0
Bulk (i.e., load from shavings mill)	10
Litter was “tilled” after it was placed in the barn	6
Litter was added to the barn during the defined risk period	0
Partial clean out performed in this barn (during the 14-day defined risk period)	0
Last full clean out:	
Prior to this flock	6
Two flocks ago	2
Three or more flocks ago	2
If a full cleanout was performed, person who performed the full cleanout:	
Grower	8
Contractor	2
Partial load-out occurred while this flock was present	0
Wild birds seen in this barn during the 14-day defined risk period	0
Types of people who entered this barn during the 14-day defined risk period:	
Federal/State veterinary or animal health worker	0
Extension agent or university veterinarian	0
Private or company veterinarian	2
Company service person	7
Nutritionist or feed company consultant	1
Bird delivery personnel	0
Vaccination crew	0
Catch crew (bird removal)	0
Feed delivery personnel	0
Egg truck personnel (for breeder farms)	0
Litter delivery services	0
Litter removal services (e.g., litter broker, litter disposal)	0
Customer (private individual)	0
Wholesaler, buyer, or dealer	0
Renderer	0
Occasional worker (e.g., family member, part time help over holiday)	3
Construction workers, repair or maintenance person	0
Other business visitors (including other producers, meter readers, package delivery (UPS), etc.)	1
Other nonbusiness visitors (including neighbors, friends, family members, and school field trips)	0
If controller information is available, average percentage of time that curtains were open and average numbers of days open or partially open during the defined risk period:	
% time	30
# days	4.2
Minimum and maximum temperatures in the barn during the 14-day defined risk period?	

Number of barns by barn characteristics	
Characteristic	**Number of barns**
Minimum	56
Maximum	66
Distance this barn (in yards) from:	
Dead bird disposal/holding area including carcass bin for rendering	128 (10 – 500)
Litter compost (for barns where litter is composted)	48 (10 – 100)
Nearest road	542 (15 – 1760)

APPENDIX C. HPAI CASE CONTROL QUESTIONNAIRE

HPAI turkeys, version 4, January 15, 2016

National Animal Health Monitoring System

2150 Centre Ave., Bldg B
Fort Collins, CO 80526

Form Approved
OMB Number 0579-0376
Approval Expires: 9/30/2017

Animal and Plant Health Inspection Service

Veterinary Services

HPAI Case Control Questionnaire Turkeys

Study ID: _____ frmid

EMRS (premises) ID: _____ premid

Date (mm/dd/yy)**:** _____ date

Interviewer instruction: Bring satellite image of farm to interview. Enter Lat and Long at farm gate.

A. PREMISES INFORMATION

Farm name: _____ frmname

Farm address: _____ frmadd

County: _____ frmcty Lat_____ lat Long_____long

1. Company flock supervisor name: _____ t101

   Phone: _____ t102 Cell phone: _____ t103 Email: _____ t104

2. Farm manager contact name: _____ t105

   Phone: _____ t106 Cell phone: _____ t107 Email: _____ t108

3. Flock veterinarian: _____ t109

   Phone: _____ t110 Cell phone: _____ t111 Email: _____ t112

B. INTERVIEWER INFORMATION

Interviewer name/organization: _____ intrname

Interviewee name/organization: _____ intename

Animal and Plant Health Inspection Service

Veterinary Services

HPAI Case Control Questionnaire

Turkeys

National Animal Health Monitoring System

2150 Centre Ave., Bldg B
Fort Collins, CO 80526

Form Approved
OMB Number 0579-0376
Approval Expires: 9/30/2017

Study ID: _____ frmid

Date (mm/dd/yy)**:** _____ date

INSTRUCTIONS

State and local poultry organizations [fill in cooperators here] and the U.S. Department of Agriculture APHIS (USDA APHIS) are conducting a case-control study as part of the highly pathogenic avian influenza (HPAI) investigation efforts to identify factors that may contribute to transmission of H5N2 influenza virus to poultry.

We are asking you to fill out this survey, which includes questions about things done daily on the farm, facility and premises condition, deliveries to the farm, and ill birds. We ask about a 2-week (14-day) period on the farm starting on a particular date that we will provide. It might be difficult to remember back that far, so please use a pocket calendar or other agenda manager and any feed and other delivery records that might be available to you.

Term	Case definition	Control definition
Premises	Farm location with flocks confirmed to be HPAI H5N2 infected by NVSL, including all barns and buildings, even if not all barns and buildings contain infected birds.	Turkey farm location with no infected birds in any barn or building, in close proximity (less than 10 miles) to the case farm. (If case farm is a turkey breeder, select a noninfected turkey breeder as the control.)
Barn	Barn or building that houses HPAI H5N2-infected birds.	On control premises, a barn or building that does not house any infected birds.

Dates of study focus:

Case farms answer questions for the timeframe of 14 days prior to the onset of clinical signs or increased mortality. All questions that ask about the "defined risk period" refer to this time period.

Control farms answer questions for the timeframe of 14 days prior to date of first detection on the matched case farm. All questions that ask about the "defined risk period" are referring to this time period.

NAHMS-348

SEP 2015

A. CASE OR CONTROL

1. Is this a case or control farm? t201

   ☐1 Case **[Go to question 2.]**

   ☐3 Control **[Go to question 3.]**

2. If this is a **case** farm,

   a. When were clinical signs or increased mortality first observed?
   This is what we will refer to as the **reference date** ..... t202 _____ mm/dd/yy

   b. Enter the date 14 days prior to the date of first detection
   (clarifying timeframe of study focus) .....t203 _____ mm/dd/yy

   All questions regarding the "defined risk period" refer to the 14 days prior to this reference date (i.e., the time between "a" and "b").

   c. How many birds were on this farm on this reference date?.....t204 _____ # birds

   d. On the reference date, was this farm in an existing control zone? .... t205..... ☐1 Yes ☐3 No

   e. When was the flock diagnosed as positive by laboratory confirmation? .....t206 _____ mm/dd/yy

   f. As of today, how many of the barns on this farm have been
   confirmed or are suspected of being infected with HPAI?.....t207 _____ # barns

   [Go to section B.]

   3. If this is a **control** farm,

   a. Enter reference date
   (enter date of matched case farm prior to interview) .....t208 _____ mm/dd/yy

   b. Enter the date 14 days prior to the reference date .....t209 _____ mm/dd/yy

   All questions regarding the "defined risk period" refer to the 14 days prior to this reference date (i.e., the time between "a" and "b").

   c. How many birds were on this farm on this reference date?.....t210 _____ # birds

   d. Is this farm located in a control zone today? .....t211 ☐1 Yes ☐3 No

   If Yes, how long has it been in a control zone? .....t212d/t212w _____ days OR _____ weeks

B. PREMISES DESCRIPTION

1. Is this a: [*Check one only.*] t301

   ☐1 Company farm?

   ☐2 Contract farm?

   ☐3 Lease farm?

   ☐4 Independent farm?

2. What stage(s) of turkey production is on this farm?

   a. Brooder ..... t302 ☐1 Yes ☐3 No

   b. Grower ..... t303 ☐1 Yes ☐3 No

   c. Breeder ..... t304 ☐1 Yes ☐3 No

   d. Other (specify: _____) t305oth ..... t305 ☐1 Yes ☐3 No

[If question 2a OR question 2b = No, SKIP to question 4.]

3. Are brooders and growers: *[Check one only.]* t306

   ☐1 In the barn at the same time?

   ☐2 In the same barn but at different times (e.g., placed as brooders and remain through grow-out)?

   ☐3 In different barns?

4. What is the sex of the market type on this farm? *[Check one only.]* t307

   ☐1 Hens (HH or LH)

   ☐2 Toms (FP)

   ☐3 Both hens and toms (i.e., multiple market classes)

   ☐4 Breeder hens

   ☐5 Breeder toms

5. Is this farm multiple age or single age? *[Check one only.]* t308

   ☐1 Multiple age

   ☐2 Single age

6. What other type(s) of poultry is present on this farm?

   a. Broiler..... t309 ☐1 Yes ☐3 No

   b. Layer..... t310 ☐1 Yes ☐3 No

   c. Other (specify: _____) t311oth ..... t311 ☐1 Yes ☐3 No

7. Is this farm certified organic? ..... t312 ☐1 Yes ☐3 No

8. Is this facility enrolled in NPIP? ..... t313 ☐1 Yes ☐3 No

9. How many barns are on this farm? ..... t314 _____ # barns

10. Do any birds on the farm have access to the outdoors? ..... t315 ☐1 Yes ☐3 No

11. Are the following water body type(s) visible or within 350 yards (about three football fields) of this farm?

    a. Pond ..... t316 ☐1 Yes ☐3 No

    b. Lake ..... t317 ☐1 Yes ☐3 No

    c. Stream ..... t318 ☐1 Yes ☐3 No

    d. River ..... t319 ☐1 Yes ☐3 No

    e. Wetland or swamp ..... t320 ☐1 Yes ☐3 No

    f. Wastewater lagoon ..... t321 ☐1 Yes ☐3 No

    g. Other (specify: _____) t322oth ..... t322 ☐1 Yes ☐3 No

12. For those water bodies within 350 yards, approximately how many of the following types of waterfowl were seen on the water during the 14-day defined risk period?

    a. Ducks ..... t323 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

    b. Geese ..... t324 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

    c. Shorebirds (e.g., wading birds, gulls) ..... t325 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

    d. Other (specify: _____) t326oth ..... t326 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

13. What is the approximate distance (in yards) to the closest field where crops or hay are harvested? ..... t327 _____ yards

14. What crop was last grown in this field? *[Check one only.]* t328

    ☐1 Corn

    ☐2 Soybeans

    ☐3 Alfalfa or grass intended for livestock feed

    ☐4 Other (specify: _____) t328oth

15. Was this field tilled last fall? ..... t329 ☐1 Yes ☐3 No ☐4 Don't know

16. Was this field actively worked (e.g., tilled, disked, hay harvested, trees cut, row crops harvested) during the 14-day defined risk period? ..... t330 ☐1 Yes ☐3 No ☐4 Don't know

17. For this closest field, approximately how many of the following types of waterfowl were seen during the 14-day defined risk period?

a. Ducks ..... t331 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

b. Geese ..... t332 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

c. Shorebirds (e.g., wading birds, gulls) ..... t333 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

d. Other (specify: _____) t334oth ..... t334 ☐1 None ☐2 Tens ☐3 Hundreds ☐4 Thousands ☐5 Don't know

18. What other types of animals are present on the farm premises?

a. Beef cattle ..... t335 ☐1 Yes ☐3 No

b. Dairy cattle ..... t336 ☐1 Yes ☐3 No

c. Horses ..... t337 ☐1 Yes ☐3 No

d. Sheep ..... t338 ☐1 Yes ☐3 No

e. Goats ..... t339 ☐1 Yes ☐3 No

f. Pigs ..... t340 ☐1 Yes ☐3 No

g. Dogs ..... t341 ☐1 Yes ☐3 No

h. Cats ..... t342 ☐1 Yes ☐3 No

i. Poultry or domesticated waterfowl (noncommercial) ..... t343 ☐1 Yes ☐3 No

j. Other (specify: _____) t344oth ..... t344 ☐1 Yes ☐3 No

19. What is the water source for poultry?

a. Municipal ..... t345 ☐1 Yes ☐3 No

b. Well ..... t346 ☐1 Yes ☐3 No

c. Surface water (e.g., pond) ..... t347 ☐1 Yes ☐3 No

d. Other (specify: _____) t348oth ..... t348 ☐1 Yes ☐3 No

20. Are the following water treatments used in the drinking water for the poultry on this farm?

a. Chlorination ..... t349 ☐1 Yes ☐3 No

b. Acidifiers ..... t350 ☐1 Yes ☐3 No

c. Iodine ..... t351 ☐1 Yes ☐3 No

d. Peroxide ..... t352 ☐1 Yes ☐3 No

e. Other (specify: _____) t353oth ..... t353 ☐1 Yes ☐3 No

21. Are windbreaks present on this farm?
If Yes, what is the distance (in yards) from the windbreak to the closest poultry barn?

Windbreak type	Present?	If Yes, distance to closest poultry barn	
a. Evergreen or juniper	☐1 Yes ☐3 No	_____ yards	t354/t357
b. Deciduous tree	☐1 Yes ☐3 No	_____ yards	t355/t358
c. Structural (e.g., hill, natural break)	☐1 Yes ☐3 No	_____ yards	t356/t359

22. Excluding driveways on farm, what is the distance (in yards or miles) from this farm to the nearest public gravel or dirt road? .....t360y/t360m _____yards OR _____ miles

23. What is the direction from this public roadway to the farm?..... t361 _____ direction

C. FARM BIOSECURITY

1. Is there a house with people living in it on the property? .....t401 ☐1 Yes ☐3 No

[If question 1 = No, SKIP to question 3.]

2. Is there a common drive entrance to farm and residence? .....t402 ☐1 Yes ☐3 No

3. How many entrances are there to the farm that could provide access to the poultry area? .....t403 _____ #

4. What best describes the road surface on this farm that vehicles coming onto the operation drive on? *[Check one only.]* t404

☐1 Hard top/asphalt

☐2 Gravel

☐3 Dirt

☐4 Other (specify: _____) t404oth

5. In general, do the following types of vehicles:

Codes for question 5
1 = come to the perimeter of the farm only
2 = enter the farm but not near the barns
3 = come near the barns
4 = do not come at all

Enter the codes that apply.

a. Garbage/dumpster pick up?.....t405 _____ code

b. Propane delivery?.....t406 _____ code

c. Feed delivery? .....t407 _____ code

d. Renderer?.....t408 _____ code

e. Company personnel (e.g., catch/vaccination crew, barn workers, service person, veterinarian)?.....t409 _____ code

f. Other business visitors (e.g., meter reader, repairman)? .....t411 _____ code

6. Is there a gate to this farm entrance? .....t412 ☐1 Yes ☐3 No

[If question 6 = No, SKIP to question 8.]

7. Is the gate secured/locked? .....t413 ☐1 Yes ☐3 No

8. Is the farm area perimeter surrounded by a security fence?.....t414 ☐1 Yes ☐3 No

9. How frequently is vegetation mowed/bush hogged on the premises (answer for when vegetation is present, e.g., spring and summer).....t415 _____ times/month

10. Was there a wash station/spray area being used for vehicles during the 14-day defined risk period? .....t416 ☐1 Yes ☐3 No

[If question 10 = No, SKIP to question 12.]

11. For wash station/spray area:

    a. Is it located on the farm? ..... t417 ☐1 Yes ☐3 No

    b. Are the tires washed? ..... t418 ☐1 Yes ☐3 No

    c. Is the vehicle exterior washed? ..... t419 ☐1 Yes ☐3 No

    d. Is the vehicle interior cleaned (e.g., floor mats) ..... t420 ☐1 Yes ☐3 No

    e. Which vehicles are washed:

        i. Worker vehicles? ..... t421 ☐1 Yes ☐3 No

        ii. Feed trucks? ..... t422 ☐1 Yes ☐3 No

        iii. Vehicles delivering/removing birds? ..... t423 ☐1 Yes ☐3 No

        iv. Other? (specify: _____) t424oth ..... t424 ☐1 Yes ☐3 No

    f. What disinfectant is used? _____ t425

    g. Was the wash station: [*Check one only.]* t426

        ☐1 Recently put into use as a response to heightened biosecurity concerns?

        ☐2 A permanent station (i.e., in use prior to the HPAI incident)?

12. Did workers and visitors always, sometimes, or never park in a restricted area away from the poultry barns during the 14-day defined risk period?

    a. Workers ..... t427 ☐1 Always ☐2 Sometimes ☐3 Never

    b. Visitors ..... t428 ☐1 Always ☐2 Sometimes ☐3 Never

13. What pest and wildlife control measures were used on this farm during the 14-day defined risk period?

    a. Rat and mouse bait stations? ..... t429 ☐1 Yes ☐3 No

    If Yes, how frequently are they checked? ..... t430 _____ times/month

    b. Beetle control? ..... t431 ☐1 Yes ☐3 No

    If Yes, what type was used?

        i. Sprays ..... t432 ☐1 Yes ☐3 No

        ii. Boric acid ..... t433 ☐1 Yes ☐3 No

        iii. Baits ..... t434 ☐1 Yes ☐3 No

        iv. Other (specify: _____) t435oth ..... t435 ☐1 Yes ☐3 No

c. Fly control (other than manure removal)? ..... b436 ☐1 Yes ☐3 No

If Yes, what type was used?

i. Residual spray ..... t437 ☐1 Yes ☐3 No

ii. Baits ..... t438 ☐1 Yes ☐3 No

iii. Larvacide (spot treatment) ..... t439 ☐1 Yes ☐3 No

iv. Larvacide in feed ..... t440 ☐1 Yes ☐3 No

v. Space sprays/fogger ..... t441 ☐1 Yes ☐3 No

vi. Biological predators ..... t442 ☐1 Yes ☐3 No

vii. Other (specify: _____) t443oth ..... t443 ☐1 Yes ☐3 No

14. How often were rodents observed in the poultry barns during the 14-day defined risk period?
[*Check one only*.] t444

☐1 Frequently (e.g., daily)

☐2 Occasionally (e.g., weekly)

☐3 Never

15. What was the intensity of beetles observed in the poultry barns during the 14-day defined risk period? t445
[Check one only.]

☐1 High

☐2 Medium

☐3 Low

☐4 Never

16. What was the intensity of flies observed in the poultry barns during the 14-day defined risk period? t446
[Check one only.]

☐1 High

☐2 Medium

☐3 Low

17. Were wild mammals, such as raccoons, opossums, coyotes, or foxes (or evidence of their presence), seen in or around poultry barns during the 14-day defined risk period? ..... t447 ☐1 Yes ☐3 No

18. During the 14-day defined risk period, prior to feeding, how frequently did wild birds, wild animals, and rodents have access to poultry feed (i.e., feed spillage, open bag, cover left open)?

	Always/ nearly always	Most of the time	Sometimes	Never	
a. Wild birds	☐1	☐2	☐3	☐4	t448
b. Wild animals such as raccoons, opossums, coyotes, or foxes	☐1	☐2	☐3	☐4	t449
c. Rodents	☐1	☐2	☐3	☐4	t450

19. Describe the protocol or plan for when feed spills on your farm: t451

_____

20. What form of feed is fed to the poultry?

a. Mash ..... t452 ☐1 Yes ☐3 No

b. Pellets ..... t453 ☐1 Yes ☐3 No

c. Other (specify: _____) t454oth ..... t454 ☐1 Yes ☐3 No

21. Is the feed treated with formaldehyde (i.e., Termin-8)? ..... t455 ☐1 Yes ☐3 No

22. Is the feed heat treated? ..... t456 ☐1 Yes ☐3 No

D. WILD BIRDS

1. How frequently were the following types of wild birds seen on the farm, but outside of the barns (within 100 yards), during the 14-day defined risk period?

Bird type	Often	Sometimes	Never	
a. Waterfowl (e.g., ducks, geese)	☐1	☐2	☐3	t501
b. Gulls	☐1	☐2	☐3	t502
c. Small perching birds (e.g., sparrows, starlings, swallows)	☐1	☐2	☐3	t503
d. Blackbirds and crows	☐1	☐2	☐3	t504
e. Other water birds (e.g., egrets, cormorants)	☐1	☐2	☐3	t505
f. Wild turkeys, pheasants, quail	☐1	☐2	☐3	t506
g. Raptors (e.g., eagles, hawks, owls)	☐1	☐2	☐3	t507
h. Pigeons and doves	☐1	☐2	☐3	t508
i. Other (specify: _____) t509oth	☐1	☐2	☐3	t509

2. How frequently were the following types of wild birds seen in the barns during the 14-day defined risk period?

Bird type	Often	Sometimes	Never	
a. Large birds (e.g., pigeons, crows)	☐1	☐2	☐3	t510
b. Small birds (e.g., finches, sparrows, starlings)	☐1	☐2	☐3	t511
c. Other (specify: _____) t512oth	☐1	☐2	☐3	t512

3. Did you observe any of the following types of **dead** wild birds **in** the barns or **outside** of the barns during the 14-day defined risk period?

Dead bird type	Inside the barns?	Outside the barns?	
a. Large birds (e.g., pigeons, crows)	☐1 Yes ☐3 No	☐1 Yes ☐3 No	t513/t516
b. Small birds (e.g., finches, sparrows, starlings)	☐1 Yes ☐3 No	☐1 Yes ☐3 No	t514/t517
c. Other (specify: _____) t515oth	☐1 Yes ☐3 No	☐1 Yes ☐3 No	t515/t518

E. FARM HELP/WORKERS

Questions in this section refer to persons such as the producer, employees, farm help, crews, etc.

1. What is the total number of employees working on this farm that have access to or directly work with poultry (including family, both paid and unpaid)?..... t601 _____ #

2. During the 14-day defined risk period, were the following measures always/nearly always, most of the time, sometimes, or never required for workers entering the poultry barns?

Measure	Always/ nearly always	Most of the time	Sometimes	Never	
a. An established clean/dirty line	☐1	☐2	☐3	☐4	t602
b. Shower	☐1	☐2	☐3	☐4	t603
c. Wash hands or use hand sanitizer before entering and/or before leaving the barn	☐1	☐2	☐3	☐4	t604
d. Different personnel for different barns	☐1	☐2	☐3	☐4	t605
e. Wear disposable coveralls	☐1	☐2	☐3	☐4	t606
f. Change of clothing (washable)	☐1	☐2	☐3	☐4	t607
g. Change of shoes or use of shoe covers	☐1	☐2	☐3	☐4	t608
h. Foot bath (liquid)	☐1	☐2	☐3	☐4	t609
i. Foot bath (dry)	☐1	☐2	☐3	☐4	t610
j. Scrub footwear (bucket and brush)	☐1	☐2	☐3	☐4	t611

3. Do workers on this farm work on other company farms? .....t612 ☐1 Yes ☐3 No

4. Are workers or members of their household employed by other poultry operations, rendering plants, or processing plants? .....t613 ☐1 Yes ☐3 No

5. Do any employees own their own poultry, including small backyard flocks? ..... t614 ☐1 Yes ☐3 No ☐4 Don't know

6. Are employees required to stay off farm after exposure to other poultry? .....t615 ☐1 Yes ☐3 No

   If Yes, for how long (hours)?.....t616 _____ hours

F. FARM VISITORS

1. Is a visitor log used to record visitor traffic onto the farm?.....t701 ☐1 Yes ☐3 No

2. Did any of the following types of people visit the farm during the 14-day defined risk period? If Yes, how many times did they visit and did they enter the poultry barn?

Visitor type	Did they visit the farm?	If Yes… How many times did they visit?	If Yes… Did this visitor enter the poultry barn?	
a. Federal/State veterinary or animal health worker	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t702/t721/t740
b. Extension agent or university veterinarian	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t703/t722/t741
c. Private or company veterinarian	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t704/t723/t742
d. Company service person	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t705/t724/t743
e. Nutritionist or feed company consultant	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t706/t725/t744
f. Bird delivery personnel	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t707/t726/t745
g. Vaccination crew	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t708/t727/t746
h. Catch crew (bird removal)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t709/t728/t747
i. Feed delivery personnel	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t710/t729/t748
j. Egg truck personnel (for breeder farms)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t711/t730/t749
k. Litter delivery services	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t712/t731/t750
l. Litter removal services (e.g., litter broker, litter disposal)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t713/t732/t751
m. Customer (private individual)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t714/t733/t752
n. Wholesaler, buyer, or dealer	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t715/t734/t753
o. Renderer	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t716/t735/t754

p. Occasional worker (e.g., family member, part-time help over holiday)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t717/t736/t755
q. Construction workers, repair or maintenance personnel	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t718/t737/t756
r. Other business visitors (including other producers, meter readers, package delivery (UPS), etc.)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t719/t738/t757
s. Other nonbusiness visitors (including neighbors, family members, friends, and school field trips)	☐1 Yes ☐3 No	_____ # visits	☐1 Yes ☐3 No	t720/t739/t758

3. For those visitors who entered the poultry barn during the 14-day defined risk period, did you require the following?

	Yes, verified at farm	Yes, visitor responsibility	No	
a. Change of outer clothing/ farm specific clothing	☐1	☐2	☐3	t759
b. Foot covers or change of footwear	☐1	☐2	☐3	t760
c. Mask	☐1	☐2	☐3	t761
d. Hand sanitizing or gloves	☐1	☐2	☐3	t762
e. Not visit multiple farms in the same day	☐1	☐2	☐3	t763
f. Other (specify:_____) t764oth	☐1	☐2	☐3	t764

G. FARM VEHICLES AND EQUIPMENT

1. Were the following vehicles shared with another farm during the 14-day defined risk period?

Vehicle type	Shared with another farm?	
a. Company trucks/trailers (e.g., pickup truck, trailer with supplies, supervisor truck, etc.)	☐1 Yes ☐3 No	t801
b. Feed trucks	☐1 Yes ☐3 No	t802
c. Bird delivery vehicles (i.e., placing birds)	☐1 Yes ☐3 No	t803
d. Bird removal vehicles	☐1 Yes ☐3 No	t804
e. Egg removal vehicles (for breeder farms)	☐1 Yes ☐3 No	t805
f. Manure/litter hauling	☐1 Yes ☐3 No	t806
g. ATV/4-wheeler	☐1 Yes ☐3 No	t807
h. Other (specify: _____) t808oth	☐1 Yes ☐3 No	t808

2. Were the following pieces of equipment shared with another farm during the 14-day defined risk period?

Equipment type	Shared with another farm?	
a. Gates/panels	☐1 Yes ☐3 No	t810
b. Lawn mowers	☐1 Yes ☐3 No	t811
c. Live haul loaders	☐1 Yes ☐3 No	t812
d. Catch pens	☐1 Yes ☐3 No	t813
e. Scales for weighing birds	☐1 Yes ☐3 No	t814
f. Vaccination equipment	☐1 Yes ☐3 No	t815
g. Pressure sprayers/washers/foamers	☐1 Yes ☐3 No	t816
h. Skid-steer loaders	☐1 Yes ☐3 No	t817
i. Litter/manure handling	☐1 Yes ☐3 No	t818
j. Tillers/de-caking equipment	☐1 Yes ☐3 No	t819
j. Other (specify: _____) t820oth	☐1 Yes ☐3 No	t820

H. LITTER HANDLING

1. What was the last day litter was brought onto the farm? .....t901 _____ mm/dd/yy

2. For the last litter (bedding) delivery, who brought the litter onto the farm?
[Check one only.] t902

☐1 Company personnel

☐2 Litter provider

☐3 Other? (specify: _____) t902oth

3. Is the litter heat treated prior to delivery? ..... t903 ☐1 Yes ☐3 No ☐4 Don't know

4. Is litter stored on the farm prior to use:

a. Outside? .....t904 ☐1 Yes ☐3 No

If Yes, is it covered? .....t905 ☐1 Yes ☐3 No

b. In a shed? .....t906 ☐1 Yes ☐3 No

If Yes, is the shed closed? .....t907 ☐1 Yes ☐3 No

[If both questions 4a and 4b = No, SKIP to question 7.]

5. What is the minimum distance (in yards) from the on-site litter storage area to the nearest barn? ..... t908 _____ yards

6. Prior to use, is litter accessible to:

   a. Wild birds? ..... t909 ☐1 Yes ☐3 No

   b. Wild animals (e.g., raccoons, opossum, coyotes, foxes)? ..... t910 ☐1 Yes ☐3 No

   c. Domestic animals (e.g., dogs, cats)? ..... t911 ☐1 Yes ☐3 No

7. What was the date that litter was last removed from any barn on this farms? ..... t912 _____ mm/dd/yy

8. How was litter disposed of most recently?

   a. Composted on-farm ..... t913 ☐1 Yes ☐3 No

      If Yes, what is the distance (in yards) to the nearest poultry barn? ..... t914 ____ yards

   b. Stored on-farm ..... t916 ☐1 Yes ☐3 No

   c. Applied to land on this farm ..... t917 ☐1 Yes ☐3 No

      If Yes, what was the date litter was applied to land? ..... t918 _____ mm/dd/yy

   d. Taken off-site ..... t919 ☐1 Yes ☐3 No

9. Has manure or used litter from other farms been spread on this farm or adjacent farms? ..... t920 ☐1 Yes ☐3 No ☐4 Don't know

I. DEAD BIRD DISPOSAL

1. What is the approximate normal daily mortality on this farm? ..... t1001 _____ #/day

Note: Ratio this number to number of birds in section A, question 2c or 3c (p 4).
Verify if the mortality is more than 0.01 (1 percent).

2. What are the method(s) of dead bird (daily mortality) disposal on this farm?

   a. Composting ..... t1002 ☐1 Yes ☐3 No

   b. Burial ..... t1003 ☐1 Yes ☐3 No

   c. Incineration ..... t1004 ☐1 Yes ☐3 No

   d. Rendering ..... t1005 ☐1 Yes ☐3 No

   e. Landfill ..... t1006 ☐1 Yes ☐3 No

   f. Other (specify: _____) t1007oth ..... t1007 ☐1 Yes ☐3 No

3. If question 2a (composting) or question 2b (burial) is Yes, how frequently are carcasses covered with:

   a. Soil? ..... t1008 ☐1 Daily ☐2 Every 2 or more days ☐3 Never

   b. Manure? ..... t1009 ☐1 Daily ☐2 Every 2 or more days ☐3 Never

4. If question 2d (rendering) is Yes,

   a. Is the carcass bin kept covered? .....t1010 ☐1 Yes ☐3 No

   b. Are carcasses: *[Check one only.]* t1011

      ☐1 Taken by the producer/worker to the renderer?

      ☐2 Picked up by the renderer from the farm?

   c. How many times were carcasses moved to the renderer during the 14-day defined risk period? ..... t1012 _____ # times

5. What do workers do after handling the carcass bin before returning to the live poultry area? t1013

   _____

   _____

   _____

6. Were any wild birds or wild mammals observed around the dead bird collection area (i.e., burial, compost pile, rendering bin, etc.) during the 14-day defined risk period?

   a. Wild birds .....t1014 ☐1 Yes ☐3 No

   b. Wild mammals.....t1015 ☐1 Yes ☐3 No

7. Is there a common collection point (i.e., located off the farm) for dead bird disposal? .....t1016 ☐1 Yes ☐3 No

   If Yes, where is the common collection point located? _____ t1017

BARN LEVEL QUESTIONS

INSTRUCTIONS:

1. **Control farm**: Select one barn to complete this section. **Answer questions for the 14 days prior to the reference date specified on page 4 (the defined risk period).**

2. **Case farm:** Select the **first** barn on this premises that was confirmed to be HPAI positive. **Answer questions for the 14 days prior to the onset of clinical signs or increased mortality (the defined risk period).**

1. What is the barn ID?		t1101
2. How many barns (flocks) are in the barn structure?	_____ # barns	
3. What separates this barn (flock) from another barn (flock)?	☐1 Separate barn structure ☐1 Fence ☐1 Solid wall	t1102
4. Are the following type(s) of poultry are present in this barn?		
a. Brooder	☐1 Yes ☐3 No	t1103
b. Grower toms	☐1 Yes ☐3 No	t1104
c. Grower hens	☐1 Yes ☐3 No	t1105
d. Breeders	☐1 Yes ☐3 No	t1106
e. Other	☐1 Yes ☐3 No If Yes, specify: _____	t1107/t1107oth
5. Did birds in this barn have outside access?	☐1 Yes ☐3 No	t1108
6. How many birds were placed in this barn?	_____ # birds	t1109
7. What was the date of placement in this barn?	_____ mm/dd/yy	t1110
8. How old were birds when placed in this barn?	_____days OR _____weeks	t1111d/t1111w
9. Were different stages of production (e.g., brooders and growers) present in this barn at the same time?	☐1 Yes ☐3 No	t1112
10. Was there another health concern in this flock during the defined risk period?	☐1 Yes ☐3 No If Yes, specify condition: _____ _____	t1113/t1113oth
11. Was this flock being treated for a condition or health concern during the defined risk period?	☐1 Yes ☐3 No	t1114
12. How old is this barn structure?	_____ years	t1115
13. How long has it been since the last remodel of the barn structure?	_____ years	t1116

14. How well has the barn structure been maintained? *[Enter code 1, 2, or 3.]* 1. Well E.g., walls, curtains, and mud boards do not have holes, no visible daylight, the barn is tight and well insulated 2. Moderate E.g., barn could have rust or small holes, mud boards may be damaged, curtains may be torn or not in good repair, curtains may not close all the way, insulation may not be in good repair, the poly may be hanging from the ceiling 3. Poor E.g., holes in walls and mud boards are apparent, tin is rusted, may have leaks in roof, there might be some holes large enough for wild birds to enter, multiple areas with daylight visible, insulation may be hanging from the ceiling	_____ code	t1117
15. What type of ventilation was used for this barn during the 14 day defined risk period? *[Enter Code 1, 2, 3, or 4.]* 1. Curtain ventilated 2. Environmental control/tunnel ventilation 3. Side doors (i.e., tip outs) 4. Other	_____ code If 4 (Other), specify: _____	t1118/t1118oth
16. If controller information is available, enter the percentage of time that curtains were open and the numbers of days open or partially open during the defined risk period.	_____ % time _____ # days	t1119pct/t1119d
17. Is intake air filtered?	☐1 Yes ☐3 No If Yes, specify type of filter: _____	t1120/t1120oth
18. What were the minimum and maximum temperatures in the barn during the 14-day defined risk period?	Minimum: _____ Maximum: _____	t1121/t1122
19. Have you had to repair or replace any feed tank lids in the past 14 days?	☐1 Yes ☐3 No	t1123
20. Have you noticed any feed tank lids open in the past 14 days?	☐1 Yes ☐3 No	t1124

21. Which best describes the ground surface immediately surrounding (within 1 yard) this barn (excluding vehicle approach and loading area). *[Enter Code 1, 2, 3, or 4.]* 1. Gravel or hard surface 2. Dirt 3. Short grass 4. Tall grass or brush	_____ code	t1125
22. Does this barn have a hard-surface entry pad (e.g., concrete, asphalt)?	☐1 Yes ☐3 No	t1126
If Yes, a. Is the entry pad cleaned and how frequently?	☐1 Yes, ☐3 No If Yes, specify frequency: _____	t1127/t1127oth
b. Is disinfectant used?	☐1 Yes ☐3 No	t1128
23. How frequently were the following used in this barn during the 14-day defined risk period?		
a. Locks on the doors	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1129
b. A service room that personnel must enter through that separates "outside area" from "inside area"	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1130
c. Changing area for employees	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1131
d. A shower for employees	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1132
e. Cool cell pads	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1133
f. Misters	☐1 Used regularly ☐2 Not used regularly ☐3 Not available	t1134
24. What type of footbath is in use at this barn? *[Enter Code 1, 2, 3, or 4.]* 1. Dry (i.e., powdered or particulate) 2. Liquid 3. Other 4. None	_____ code If 3 (Other), specify: _____ **[If 4 (None), SKIP to question 27.]**	t1135/t1135oth
25. What is the frequency that footbath solutions are changed?	_____ times/ ☐1 day, ☐2 week, or ☐3 month	t1136/t1136f
26. What disinfectant is used in the footbaths?		t1137

27. What type(s) of litter is used in this barn? *[Enter Code 1, 2, 3, or 4.]* 1. Wood shavings 2. Hulls (e.g., oat, rice, sunflower, other) 3. Straw 4. Other	_____ code If 4 (Other), specify: _____	t1138/t1138oth
28. Is the litter bagged (i.e., bailed) or bulk (i.e., load from shavings mill)?	☐1 Bag ☐2 Bulk	t1139
29. Who are the supplier(s)/source(s) of litter?		t1140
30. Was litter "tilled" after it was placed in the barn?	☐1 Yes ☐3 No	t1141
If Yes, when was it tilled?	_____ mm/dd/yy	t1142
31. How many times was litter added to the barn during the defined risk period?	_____ times	t1143
32. What was the date of the last partial clean out in this barn (during the 14-day defined risk period)?	_____ mm/dd/yy ☐1 No partial cleanout	t11441/t1144n
If a partial cleanout was done, who performed the partial cleanout? *[Enter Code 1 or 2.]* 1. Grower 2. Contractor	_____ code	t1145
If contractor, specify name and location:	Name: _____ Location: _____	t1146n/t1146l
33. When was the last full clean out? *[Enter Code 1, 2, or 3.]* 1. Prior to this flock 2. Two flocks ago 3. Three or more flocks ago	_____ code	t1147
If a full cleanout was performed, who performed the full cleanout? *[Enter Code 1 or 2.]* 1. Grower 2. Contractor	_____ code	t1148
If contractor, specify name and location:	Name: _____ Location: _____	t1149n/t1149l
34. Was there a partial load-out while this flock was present?	☐1 Yes ☐3 No	t1150
If Yes, what was the date?	_____ mm/dd/yy	t1151

35. Were the following wild birds seen in this barn during the 14-day defined risk period?		
a. Large birds (e.g., pigeons, crows)	☐1 Yes ☐3 No	t1152
b. Small birds (e.g., finches, sparrows, starlings)	☐1 Yes ☐3 No	t1153
36. How far is this barn (in yards) from:		
a. Dead bird disposal/holding area including carcass bin for rendering?	____ yards	t1154
b. Litter compost?	____ yards ☐1 Litter not composted	t1155/t1155n
c. Nearest road?	____ yards	t1156
37. Did any of the following types of people enter this barn during the 14-day defined risk period?		
a. Federal/State veterinary or animal health worker	☐1 Yes ☐3 No	t1157
b. Extension agent or university veterinarian	☐1 Yes ☐3 No	t1158
c. Private or company veterinarian	☐1 Yes ☐3 No	t1159
d. Company service person	☐1 Yes ☐3 No	t1160
e. Nutritionist or feed company consultant	☐1 Yes ☐3 No	t1161
f. Bird delivery personnel	☐1 Yes ☐3 No	t1162
g. Vaccination crew	☐1 Yes ☐3 No	t1163
h. Catch crew (bird removal)	☐1 Yes ☐3 No	t1164
i. Feed delivery personnel	☐1 Yes ☐3 No	t1165
j. Egg truck personnel (for breeder farms)	☐1 Yes ☐3 No	t1166
k. Litter delivery services	☐1 Yes ☐3 No	t1167
l. Litter removal services (e.g., litter broker, litter disposal)	☐1 Yes ☐3 No	t1168
m. Customer (private individual)	☐1 Yes ☐3 No	t1169
n. Wholesaler, buyer, or dealer	☐1 Yes ☐3 No	t1170
o. Renderer	☐1 Yes ☐3 No	t1171
p. Occasional worker (e.g., family member, part time help over holiday)	☐1 Yes ☐3 No	t1172
q. Construction workers, repair or maintenance person	☐1 Yes ☐3 No	t1173
r. Other business visitors (including other producers, meter readers, package delivery (UPS), etc.)	☐1 Yes ☐3 No	t1174
s. Other nonbusiness visitors (including neighbors, friends, family members, and school field trips)	☐1 Yes ☐3 No	t1175

CHECKLIST

INSTRUCTIONS

This section refers to data that can be acquired through other sources.

1. Please verify grayed areas from the questionnaire.

2. If possible, attach a diagram, farm map, or photographs showing orientation of barn(s), including barn numbers, water location, feed storage, rendering bin, litter storage, ventilation, and windbreaks.

3. If possible, attach photographs of exterior of study barn(s) showing:
    - Exterior structure of the study barn(s), and
    - Ventilation system including exhaust fans and air input and curtains (if present).

4. How many commercial poultry farms (of any production type) are located:
    a. Within 1 mile of this farm? ..... t1201 _____ #
    b. Within 3 miles of this farm? ..... t1202 _____ #

5. How far (in yards or miles) is the nearest backyard flock to this farm? ..... t1203y/t1203m _____ yards OR _____ miles

6. How far (in yards or miles) is the nearest HPAI-positive premises to this farm? ..... t1204y/t1204m _____ yards OR _____ miles

7. Collect feed or live haul truck routing information, if available. Determine if trucks are routed to avoid passing positive premises.

8. Collect mortality sheets from both case and control barns.

9. Collect ventilation control information, if available.

10. If available, collect weather data, including historical baselines, relative humidity, wind direction, temperature, and cloud cover.

11. Collect specific age and date of placement for each barn.

12. Which feed mill supplies feed to this farm? t1205

_____