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Mini Review

Risk Communication for Poultry Farms by Detection of HPAI (H5N1) Virus in Wild Birds during the Winter Season of 2021/2022 in the Republic of Korea

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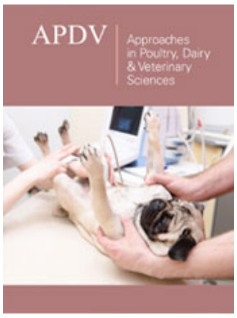
ISSN: 2576-9162



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Submission: April 26, 2022
Published: May 12, 2022

Volume 8 - Issue 5

How to cite this article: Youngmin Son, Hachung Yoon*, Ilseob Lee, Eunesub Lee. Risk Communication for Poultry Farms by Detection of HPAI (H5N1) Virus in Wild Birds during the Winter Season of 2021/2022 in the Republic of Korea. Appro Poult Dairy & Vet Sci 9(1). APDV. 000703. 2022.
DOI: 10.31031/APDV.2022.09.000703

Mini Review

The outbreak of Highly Pathogenic Avian Influenza (HPAI) is known due to the movement of migratory birds. Migratory birds change their habitats along the latitude in search of breeding and wintering sites based on temperature and length of day. The geographical route through which migratory birds move is defined as a flyway, and nine major flyways are widely known. Avian Influenza Virus (AIV) sharing may occur among migratory bird groups in breeding and wintering sites where flyways overlap, and it is spread to other parts of the world when such bird groups move back to wintering and breeding sites [1]. This mechanism can make the same AIV found in Asia, North America, and Europe. Thus, the Republic of Korea focuses on the status of Avian Influenza (AI) in wild birds and poultry in northeastern China, Mongolia, Siberia, and Alaska where summer breeding sites overlap with flyways passing through East Asia, Europe, and/or North America [2]. In 2021, the number of AIV detected in wild birds in Europe and Asia increased compared with previous years, and different types of viruses were detected. However, no detection of AIV was reported in North America at that time. The number of wild bird AI cases in Europe was 608 in 2017, 73 in 2018, one in 2019, and 771 in 2020, but 1,059 AI cases were recorded in August 2021. Different types of viruses, including H5N1, H5N3, H5N4, H5N5, H5N8, and H7N7, were detected in the first half of 2021, but after June, only H5N1 and H5N8 remained. In poultry, 1,134 HPAI outbreaks, including H5N8, H5N1, and H5N5, were confirmed by August 2021. After June, only H5N1 and H5N8 (excluding N-type unidentified H5) were observed. In Asia, 70, 31, 17, 50, and 45 AI in wild birds were recorded in 2017, 2018, 2019, 2020, and 2021, respectively. The common virus type was H5N8 with 41 cases (91.1%), and one case each of H5N1, H5N2, H5N5, and H5N6 was reported. In poultry, 260 outbreaks of HPAI were confirmed by August of 2021, of which 125 (48.1%) H5N8 and 65 (25.0%) H5N1 were the common viruses found. H5N6, H5N5, and H5N2 were also detected [3].

Using the national surveillance system on AI, the H5-type AIV in the 2021/2022 winter season in Korea was first detected on September 9, 2021. A total of 149 AIV of H5 (106 cases) and H7 (43 cases) were isolated from specimens of wild bird by April 15, 2022. The specimens included 101 feces (60 for H5 and 41 for H7), 39 dead bodies (all H5), and nine captured birds (seven for H5 and two for H7). The HPAI virus was first isolated from feces sampled on October 26, which was identified as H5N1. Until March 24, 2022, 67 cases of HPAI virus were isolated in 26 regions (cities and counties) of 11 provinces. Among them, 66 were H5N1 type and the other one (dead body of a whooper swan) was H5N8 [4]. Specimens that were highly pathogenic included 21 feces, 39 dead bodies, and seven captured birds. All specimens of H5 from dead bodies and captured birds were proven to be highly pathogenic. The dead bodies included 26 (70.3%) white-fronted geese (*Anser albifrons*); four (10.8%) eastern great egrets (*Ardea alba modesta*); two (5.4%) bean geese (*Anser fabalis*); and one of each (1.7%) spot-billed ducks (*Anas poecilorhyncha*) each, gadwall (*Anas Strepera*), white-naped crane (*Grus vipio Pallas*), mallard (*Anas platyrhynchos*), whooper swan (*Cygnus Cygnus*), and ruddy shelduck (*Tadorna ferruginea*). The seven captured birds from which HPAI virus was isolated included two (28.6%) mandarin ducks (*Aix galericulata*) and one of each (14.3%) mallards (*Anas platyrhynchos*), Eurasian wigeon (*Mareca Penelope*), spot-billed ducks (*Anas poecilorhyncha*), and unclassified duck. In addition, HPAI virus was detected in two (3.0%), eight (11.9%), seven (10.4%), 13 (19.4%), 14 (20.9%), and 23 (34.3%) wild birds in October, November, December, January, February, and March, respectively. An increase in the number of detections was observed every month, except for December, which showed a decrease of one detection from the previous month. As shown in the status in Korea in the previous season, H5 AIV detection was common in October and November when migratory birds arrived for wintering and when HPAI had not been confirmed in poultry (winter season of 2019/2020). Meanwhile, the largest number of HPAI viruses was detected in December in wild birds and poultry, when the outbreak of HPAI (H5N8) was confirmed in poultry following the detection in wild birds during winter season of 2020/2021 [5]. However, during winter of 2021/2022, a different pattern from the previous years was shown with the highest number of detections in March. A total of 47 HPAI (H5N1) outbreaks were confirmed in 23 regions of seven provinces for 150 days from November 8, 2021 to April 7, 2022, including eight (17.0%) in November, 11 (23.4%) in December, 10 (21.3%) in January, 16 (34.0%) in February, and one case (2.1%) each in March and April [6]. The number of HPAI outbreaks in poultry from December to February was partly due to the fact that the temperature drop made an environment favorable for virus survival, but it might also be associated with farmers' awareness of biosecurity. In particular, unlike previous years, the largest number of outbreaks in February cannot be assessed separately with biosecurity. Therefore, in-depth analysis must consider the ecology of wild birds and poultry, the environment, and the virus to comprehensively understand the fact that HPAI virus detection in wild birds was highest in March, but no HPAI outbreak in poultry was reported in areas where wild bird HPAI virus was intensively detected during that period.

After the detection of H5/H7 AIV from wild birds by the surveillance program, the Epidemiology Division of the Animal and Plant Quarantine Agency (APQA) tracks down the visits of the registered livestock vehicles to the poultry farms after passing through within a radius of 3km of the detecting place from the day before sampling [5]. This strategy is possible because the Korea Animal Health Integrated System (KAHIS) has established a recognition tool using Geographical Positioning System (GPS) with Information and Communication Technology (ICT) for livestock farms and livestock vehicles. Moreover, various geocoordinate sets are assigned to each farm to distinguish whether the livestock vehicle has stopped at the entrance or accessed the inside of the farm [7]. For each case of H5/H7 AIV detection in wild birds, data on farms and vehicles, whether or not the vehicles enter the farm, are provided to the animal health agencies nationwide. Reports with texts, tables, and graphs are prepared by a Robotic Process Automation (RPA) system programmed with predefined formats and procedures. Furthermore, the HPAI risk of poultry farms is calculated at regional level by synthesizing the detections of AIV in wild birds for one week. Weekly reports are also made using the RPA system. In wild birds, HPAI virus was detected for 19 weeks among the 22 weeks from October 26, 2021 to March 24, 2022. Three weeks showed no detection. The number of weekly detections showed a distribution of median 3 (first quartile Q1=1 and third quartile Q3=4). The most detected week was between March 1 and March 7, 2022, with nine cases detected in a week. A seven-day Estimated Dissemination Ratio (EDR) graph also showed the highest value over the same period, showing an increase in HPAI detection in wild birds. In addition, four periods [8] indicated an increase in HPAI virus detection with EDR of more than one, which lasted for about 10 days each in mid-November, early December 2021, late January 2022, and early mid-February 2022 (Figure 1).

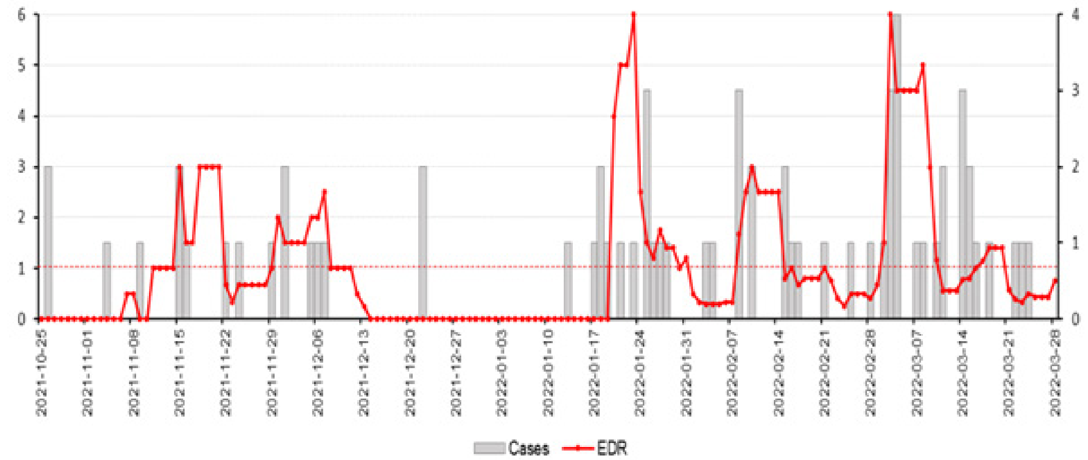

Figure 1: EDR on the number of HPAI detection in wild birds during the winter season of 2021/2022.
Source: Bars indicate the number of HPAI virus detections in each day. The solid red line indicates the EDR for 7 days. The horizontal dashed line shows the boundary with EDR=1. EDR: Estimated Dissemination Ratio, HPAI: Highly Pathogenic Avian Influenza.

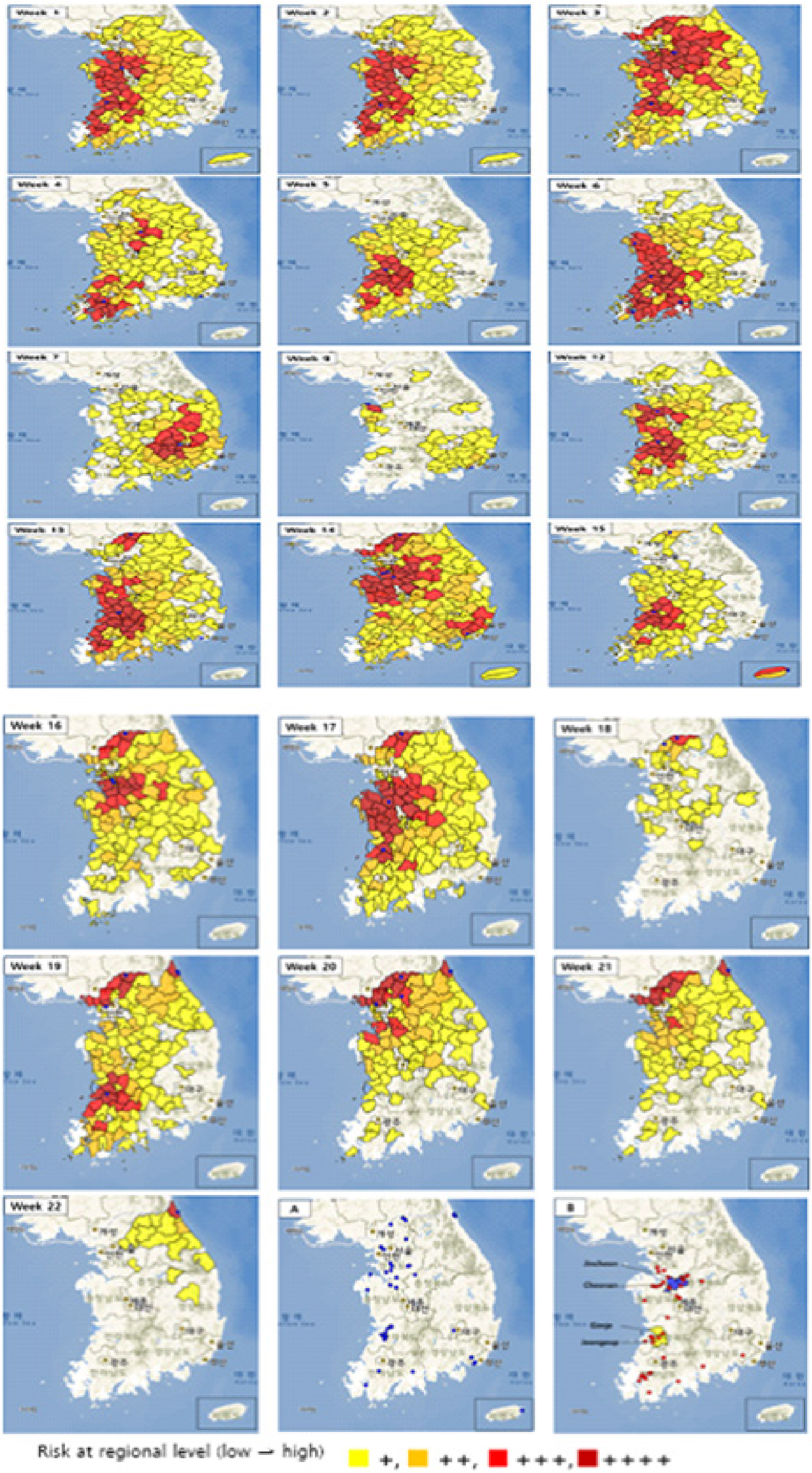

Figure 2: Distribution of weekly risk of HPAI on the poultry at regional (cities and counties) level, estimated in relation to HPAI virus detection in wild birds.
Source: No detection of HPAI virus in wild birds in weeks 8, 10, and 11. The bleu dots (weeks 1-22 & A) shows the HPAI virus detection places in wild birds. The red dots (B) shows the HPAI outbreak poultry farms.

Among the vehicles that passed within a 3 km radius of the wild bird HPAI detection place, a total of 8,878 vehicles (deduplicated) visited the poultry farm. Among these vehicles, 2,789 (31.4%) were used for animal transport, 2,400 (27.0%) for feed transport, and 954 (10.7%) by consultants. With regard to weekly terms, 721 (Q1=542 and Q3=1,284) vehicles in median visited the poultry farms after passing near the HPAI virus detection place each week, of which 481 (Q1=269 and Q3=775) or 66.7% of the visiting-farm vehicles accessed the inside of the farm. The vehicle type that visited the poultry farm the most was the animal transporter for 10 weeks, feed transporter for eight weeks, and consultant for one week. Similarly, in our previous study, from September 2020 to August 2021, the vehicle type with the largest number of visits to poultry farms was animal transporter, 86.1% of which moved within the same province. In the case of the feed transporter, 82.1% moved within the same province [9]. Farms visited by livestock vehicles after passing through the 3km radius of the wild bird HPAI detection place are distributed over two-thirds of the country. Regions with the largest number of farms visited by livestock vehicles were those close to the HPAI virus detection place. The risk of HPAI for poultry was estimated for regions where poultry farms visited by livestock vehicles are located, by considering the distribution of wild birds, movement of livestock vehicles, and the possibility of local spread. During winter season of 2021/2022, the highest risk was calculated five times (among 19 weekly analyses in relation to HPAI detection in wild birds) in Jeongeup and three times in Gimje, which was geographically located next to Jeongeup. The total number of HPAI outbreaks in poultry was three in Jeongeup and one in Gimje, which corresponds to the third largest number followed by Jincheon, Cheonan, with five outbreaks each (Figure 2).

Various measures are continuously applied to minimize damage caused by the outbreak of HPAI. This study presents Korea's efforts, including monitoring of AI status in other countries, risk assessment for poultry farms in relation to HPAI detection in wild birds, and related risk communication. Surveillance and risk communication are important in the control of HPAI as they enable information-based preparedness and preemptive response [10]. Tracking information on the movement path of livestock vehicles can assess the extent to which AIVs in outdoor environments can be spread through human activity [11]. Moreover, the AI surveillance system should be further refined with continuous efforts, including monitoring, risk assessment, and communication. Experiences of risk communication during previous seasons suggested that information is an important guideline for applying preemptive responses in the field.

Acknowledgment

This work was conducted with the support from the Animal and Plant Quarantine Agency (Research project number N-1543068-2015-99).

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