

Protecting Poultry Workers from Exposure to Avian Influenza Viruses

KATHLEEN L. MACMAHON, DVM,
MS^a

LISA J. DELANEY, MS, CIH^b

GREG KULLMAN, PhD, CIH^c

JOHN D. GIBBINS, DVM, MPH^d

JOHN DECKER, MS, CIH^{b,e}

MAX J. KIEFER, MS, CIH^f

SYNOPSIS

Emerging zoonotic diseases are of increasing regional and global importance. Preventing occupational exposure to zoonotic diseases protects workers as well as their families, communities, and the public health. Workers can be protected from zoonotic diseases most effectively by preventing and controlling diseases in animals, reducing workplace exposures, and educating workers.

Certain avian influenza viruses are potential zoonotic disease agents that may be transmitted from infected birds to humans. Poultry workers are at risk of becoming infected with these viruses if they are exposed to infected birds or virus-contaminated materials or environments. Critical components of worker protection include educating employers and training poultry workers about occupational exposure to avian influenza viruses. Other recommendations for protecting poultry workers include the use of good hygiene and work practices, personal protective clothing and equipment, vaccination for seasonal influenza viruses, antiviral medication, and medical surveillance. Current recommendations for protecting poultry workers from exposure to avian influenza viruses are summarized in this article.

^aEducation and Information Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH

^bEmergency Preparedness and Response Office, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Atlanta, GA

^cDivision of Respiratory Disease Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, WV

^dDivision of Surveillance, Hazard Evaluations and Field Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH

^eCurrent affiliation: Division of Emergency and Environmental Health Services, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA

^fDenver Regional Office, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Denver, CO

Address correspondence to: Kathleen L. MacMahon, DVM, MS, Education and Information Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, MS-C32, 4676 Columbia Pkwy., Cincinnati, OH 45230; tel. 513-533-8547; fax 513-533-8230; e-mail <KMacMahon@cdc.gov>.

Emerging zoonotic diseases are of increasing regional and global importance. Approximately 75% of emerging infectious diseases are zoonotic.¹ Occupational zoonoses are diseases that may be transmitted from animals to people in the workplace. Workers may be exposed to zoonotic disease agents if they work directly with infected animals or animal products, with tissues or samples from infected animals, or in pathogen-contaminated environments. Workers can be protected from zoonotic disease agents most effectively by preventing and controlling diseases in animals, early disease detection, ensuring that only trained employees work with animals, and reducing workplace exposures using optimum control strategies. Those who work with production, companion, wild, and zoo animals are the interface between these animal populations and their human communities. Minimizing workplace exposure to zoonotic diseases protects workers as well as their families, communities, and the public health.

Certain avian influenza (AI) viruses are potential zoonotic disease agents that may be transmitted from infected poultry to humans. Poultry workers who are exposed to infected birds, poultry products, or virus-contaminated materials or environments have an occupational risk of exposure to these viruses. Current recommendations for protecting poultry workers from exposure to AI viruses are summarized in this article.²⁻⁵ Recommendations for protecting other workers at risk are available.^{2,6,7}

POULTRY WORKERS AT RISK

Poultry workers at risk of exposure to AI viruses are those people working in the various poultry production systems or sectors, including poultry farmers and their employees; service technicians of poultry-processing facilities; caretakers at poultry facilities; layer barn workers; workers in live bird markets; chick workers at egg production facilities; disease control and eradication workers; and workers in the bird-fighting industry.² Other workers at risk of exposure to potentially infected poultry include veterinarians and their staff, poultry transportation workers, and slaughterhouse workers.⁸ Anyone who handles or works with AI-infected poultry or in environments contaminated with the secretions or excretions of AI-infected birds is at risk of exposure and potential infection.

BACKGROUND INFORMATION ABOUT AI

AI is an infectious disease of birds caused by type A influenza viruses. AI virus subtypes are classified by a combination of two groups of proteins known as

hemagglutinin and neuraminidase. These viruses are found in certain species of waterfowl and shorebirds; such birds are natural reservoirs of all 16 hemagglutinin and nine neuraminidase subtypes. AI viruses are further classified on the basis of genetic features of the virus or the severity of disease in poultry.

Low pathogenic AI (LPAI) occurs naturally in wild birds and can spread to domestic birds. In most cases, LPAI causes no signs of infection or minor symptoms in birds. The LPAI H5 and H7 subtypes have the potential to mutate into highly pathogenic AI (HPAI) and should be closely monitored. HPAI viruses spread rapidly and are often fatal to poultry. An example is the ongoing HPAI H5N1 epizootic in parts of Asia and Africa. More than 150 million birds have died or been destroyed in countries where HPAI H5N1 has been detected. This virus has also infected humans, most of whom had direct contact with infected birds or environments contaminated with secretions or excretions from infected birds. As of January 8, 2008, HPAI H5N1 has not been detected in the U.S.⁹

Workers need to be protected against both LPAI and HPAI viruses. Human illness due to infection with LPAI viruses has been documented, typically with mild to moderate symptoms of conjunctivitis or influenza-like illness. Human infection with HPAI viruses has ranged from mild symptoms to severe and fatal disease.¹⁰

An example of an HPAI outbreak with human infections was an outbreak of HPAI H5N1, first recognized in 1997 in Hong Kong with 18 cases, including six deaths.¹¹ The culling of all chickens in markets and facilities throughout Hong Kong, as well as meticulous cleaning and disinfection of these premises and import bans from surrounding areas, was credited with stopping the outbreak in both birds and humans.¹² Since late 2003, outbreaks of HPAI H5N1 in poultry and human infections have been reported in multiple countries. Between December 2003 and May 2007, more than 5,000 outbreaks of HPAI H5N1 in poultry from 41 countries were reported to the World Organization for Animal Health (OIE).¹³ HPAI H5N1 infections and die-offs have also been reported in wild birds and multiple mammalian species, including domestic cats, stone martins, and leopards and tigers in zoos.¹⁴ According to the World Health Organization (WHO), 348 human cases of HPAI H5N1 (including 216 deaths) were confirmed as of January 3, 2008, from a total of 14 countries.¹⁵

In the U.S., three outbreaks of HPAI subtypes other than H5N1 have occurred in poultry: in 1924, 1983, and 2004.¹⁶ None of these HPAI outbreaks resulted in recognized human illness.

PREVENTING AND CONTROLLING AI IN POULTRY

The most effective way to protect poultry workers from exposure to AI viruses is to prevent, detect, and control infection in poultry.¹⁷ This strategy is key in the U.S. Department of Agriculture (USDA) AI efforts.¹⁸ A cornerstone of the USDA strategy is to prevent HPAI strains from being introduced into the U.S. This has been accomplished to date by restricting imports of live poultry, unprocessed poultry products, and hatching eggs from AI-infected countries. The USDA is also assisting AI-affected nations by supporting U.S. government efforts through the International Partnership on Avian and Pandemic Influenza.¹⁹

Another key component to preventing the introduction of AI viruses into susceptible poultry populations is biosecurity. Biosecurity, as optimally practiced in U.S. commercial poultry flocks, includes but is not limited to: (1) restricting visitors to poultry farms, (2) prohibiting farm workers from visiting other farms or personally owning birds or poultry, (3) all-in-all-out production with birds of the same age obtained from a single source, (4) confinement housing, which limits contact with wild bird and animal populations, (5) rodent and insect control, (6) strict disinfection and waste disposal, and (7) ongoing AI virus monitoring and surveillance in poultry flocks.²⁰

Guidelines for the prevention and control of AI in poultry include: recommendations for early warning and detection; early, voluntary, and transparent notification by affected countries to international organizations charged with protecting animal and human health; and rapid response.²¹ Robust animal health surveillance and veterinary diagnostic laboratory capabilities are vital for detecting outbreaks at an early stage, when control efforts can be successful. Limited detection and response capability in many regions of the world where the HPAI H5N1 epizootic is occurring has contributed to the rapid spread and persistence of this virus in bird populations.

Transparent notification includes early reporting of suspected and/or confirmed AI outbreaks from individual owners up to and including state, national, and international notification to the OIE and other health organizations, as per compliance with national and international notification and reporting requirements. Notification may be delayed if poultry owners are not ensured adequate compensation for birds destroyed during response activities. Also, fear of economic loss through trade sanctions and loss of tourism may delay international notification of outbreaks in poultry. Contingency planning and training exercises are necessary for the timely and effective response to AI outbreaks.

While outbreak responses must be rapid to be effective, steps must be taken to prevent unintentional spread of disease to other poultry flocks, poultry workers, or workers involved in culling operations. Culling, or the destruction of infected or potentially exposed populations of birds, must be done efficiently, but with consideration for the humane handling of birds and proper carcass disposal.²²

Strict adherence to biosecurity is critical to prevent the introduction of AI and other diseases into poultry flocks. If an outbreak occurs, early detection and rapid response measures are vital to limit the spread of infection. Protecting poultry health by using these measures decreases the potential for worker exposure to infected birds and decreases their occupational risk of infection.

RECOMMENDATIONS FOR PROTECTING POULTRY WORKERS

The Occupational Safety and Health Act of 1970 (Public Law 91-596) mandates that employers provide their workers with a safe and healthful workplace. In the U.S., federal agencies charged with protecting worker health, human health, production animal health, and wildlife health have collaborated to develop guidance for workers potentially exposed to AI viruses. The development of workplace recommendations for protecting poultry workers from AI viruses is based on the current scientific knowledge about these viruses, including their transmission, infectivity, severity, and persistence. AI viruses can be found in the droppings, saliva, and nasal secretions of infected birds. The virus is most often passed to humans from contact with sick or dead poultry. Transmission also may occur if the mouth, nose, or eyes are contacted with virus or virus-contaminated materials such as droppings, feathers, litter, egg flats, or cages.

Guidance is updated as new information becomes available. Recommendations for protecting poultry workers before an outbreak include provisions for response planning, training workers, and medical countermeasures such as seasonal influenza vaccination. During a confirmed or suspected HPAI outbreak, the following recommendations should be implemented: increased infection control practices and the use of personal protective equipment (PPE), antiviral medication, and medical surveillance.²⁻⁵ Strict adherence to these recommendations is essential to prevent possible human infection. Although the human health risk of exposure to LPAI viruses is not known, following these recommendations is prudent for all workers likely to have prolonged exposure to any AI virus in an enclosed setting.

Training

Poultry workers should be trained by their employers to recognize the clinical signs of respiratory disease in poultry so that sick or dead birds can be reported and immediate action can be taken to protect worker health when infection is suspected. The signs of illness in domestic poultry infected with AI viruses are variable and are affected by the virus subtype, age and species of infected birds, concurrent bacterial disease, and the environment. Such signs may include sudden death; lack of coordination; purple discoloration of the wattles, combs, and legs; soft-shelled or misshapen eggs; lack of energy and appetite; diarrhea; swelling of the head, eyelids, comb, wattles, and hocks; nasal discharge; decreased egg production; and coughing or sneezing. Some infected birds may not show any clinical signs. The severity of disease in poultry may vary during an outbreak. Workers should be trained to report sick or dead birds to the appropriate management representative so that prompt action can be taken.

All poultry workers should be trained to recognize the signs and symptoms of AI virus infection in humans so that measures can be taken for immediate medical treatment when necessary. The signs and symptoms in humans are nonspecific and vary with the virus subtype. They may include fever, cough, sore throat, conjunctivitis, muscle aches, and diarrhea. Infection with AI viruses can also lead to pneumonia, acute respiratory distress, and other severe and life-threatening complications. Workers should be trained to be vigilant in monitoring and reporting the development of fever, respiratory symptoms, and/or conjunctivitis for one week after their last exposure to AI-infected birds or to virus-contaminated materials or environments. Each workplace should have a medical surveillance system that monitors, records, and assesses workplace injuries and illnesses, including the symptoms and absenteeism associated with AI infection. Workers who become ill should promptly seek medical care and notify their safety and health representative or other management representative. Their health-care provider should be notified about the possible AI exposure before the ill worker arrives at the medical facility.

Workers should receive training on the proper use, care, and maintenance of PPE, including cleaning, inspection, and storage. The PPE must be worn correctly to be effective. Workers should follow proper donning and doffing procedures to avoid contaminating their hands and face when removing the protective gear. Biosecurity protocols may require stringent PPE use for infection control and to protect personnel from decontamination agents. The PPE may create a potential heat-stress hazard and limit workers' agility

or dexterity. As such, workers should be trained about the signs and symptoms of heat stress-related illnesses and how to prevent such illnesses.

Protective clothing

Poultry workers should wear personal protective clothing whenever they may be exposed to AI viruses. This protective clothing should include gloves, aprons, outer garments or coveralls, boots or boot covers, and a disposable head cover or hair cover. Protective clothing should be selected to prevent skin contact with virus-contaminated materials or environments. Consideration should be given to the type of work being performed by the worker when selecting personal protective clothing. Protective outer garments such as aprons or coveralls should include impermeable, disposable protective clothing with breathability when possible. Although disposable protective clothing is preferred, workers may use outer garments that can be effectively disinfected. Lightweight clothing should be selected when appropriate to protect workers from heat stress. For example, choose a lightweight, impermeable coverall instead of a chemical-resistant suit.

Select lightweight, disposable gloves or heavy-duty rubber gloves that are reusable after disinfection. Select PPE on the basis of activities performed by the worker, dexterity requirements, and the need for glove durability and resistance to tearing and abrasion. Gloves should be waterproof.

Select boots that can be disinfected or durable boot covers that can be discarded after use to protect workers from contact with harmful agents and prevent them from carrying these agents from one location to another. Good biosecurity and PPE practices will reduce the chances of carrying the AI virus off the contaminated premises.

Eye protection

Eye protection is important to prevent eye contact with virus-contaminated dusts, droplets, and aerosols and to keep workers from touching their eyes with contaminated fingers or gloves.²³ Select unvented safety goggles (i.e., eyecup goggles) or indirectly vented safety goggles. If indirectly vented goggles are properly fitted and have a good antifog coating, they may be used by poultry workers with a low risk of exposure to AI. However, such goggles are not airtight and will not prevent exposure to airborne material.

Respiratory protection

Poultry workers should wear respirators because AI viruses may be transmitted by breathing contaminated dusts, droplets, or aerosols. Workers should wear a

National Institute for Occupational Safety and Health (NIOSH)-certified, air-purifying respirator with a particulate filter whenever they are working in poultry barns or may be exposed to infected poultry or virus-contaminated materials or environments. Disposable particulate respirators (e.g., N-95, N-99, or N-100) are the minimum level of respiratory protection that should be worn.²⁻⁵ Numerous factors must be considered when selecting the appropriate respirator, including the task(s) to be conducted, the work environment, and duration of the activity. Depending on these factors, respirators with higher levels of protection and reliability may be warranted. Alternative methods for conducting these activities or controlling exposure should always be considered for those activities requiring respiratory protection. Some examples include using mechanical (enclosed tractor cab) handling vs. direct manual handling of dead or diseased poultry, providing adequate ventilation, and using dust suppression (wet) techniques.

Respirators should be used in the context of a comprehensive respiratory protection program, as required by the Occupational Safety and Health Administration respiratory protection standard.^{24,25} This program should be administered by a qualified program administrator and should include training, fit testing, and fit checking to ensure proper respirator selection and use. To be effective, respirators must provide a proper sealing surface on the wearer's face.

Work practices

Good hygiene and decontamination procedures should be used to prevent infection and take-home contamination. Proper donning and doffing procedures should be followed and PPE should be discarded in approved containers. Workers should wash their hands immediately after removal of PPE. If hand-washing facilities are not available, waterless soaps or alcohol-based sanitizers may be used. Workers should shower at the end of the work shift and leave all contaminated clothing and equipment at work to prevent take-home contamination.

Antiviral medication and seasonal influenza vaccine

The Centers for Disease Control and Prevention (CDC) recommends that workers involved in HPAI control and eradication activities receive a prophylactic antiviral drug daily for the entire time they are in direct contact with infected poultry or with virus-contaminated materials or environments, and for one week following their last exposure.³ CDC also recommends the current season's influenza vaccine for workers involved in HPAI control activities. Other poultry workers should

also consider getting the current season's influenza vaccine on an annual basis. Although this vaccine will not prevent AI infection, including HPAI H5N1 infection, it could prevent dual infection and possible reassortment of the virus.

DISCUSSION

Evaluating AI virus transmission in humans exposed to infected poultry has been technically difficult.^{26,27} However, several studies indicate that workers have been infected during AI outbreaks in poultry.²⁷⁻³³ A serological evaluation of workers exposed during the HPAI H5N1 outbreak in Hong Kong in 1997 found that approximately 3% of government workers involved in the poultry culling operation and 10% of poultry workers were seropositive.²⁸ During a 2003 outbreak of HPAI H7N7 in the Netherlands, infection was confirmed in 89 people, with conjunctivitis being the predominant symptom reported.²⁷ Most confirmed cases had contact with poultry, but three cases had exposure only to infected people. Approximately 50% (250/500) of people exposed to infected poultry and 59% (36/62) of family members tested had an antibody response. Cullers and veterinarians had the highest estimated attack rate of confirmed infection; one veterinarian died.²⁹

A serological survey of Italian poultry workers reported H7 antibodies in 3.8% of workers exposed during the 2003 LPAI H7N3 poultry outbreak.³⁰ A 2007 LPAI H7N3 outbreak in poultry in the United Kingdom resulted in conjunctivitis in an infected poultry worker.³¹ A study of U.S. veterinarians who worked with birds reported they had significantly higher H5, H6, and H7 antibody levels than a control group.³² These studies demonstrate the importance of protecting poultry workers when an AI outbreak in poultry is suspected or confirmed.

Several studies indicate that workers have not been adequately protected during HPAI outbreaks in poultry.³³⁻³⁵ During the 2003 HPAI H7N7 outbreak in poultry in the Netherlands, compliance with the use of preventive measures was poor in poultry farmers and outbreak responders.³³ Workers cited problems in their use of PPE, particularly safety goggles. During a 2004 HPAI H7N3 outbreak in poultry in British Columbia, Canada, two workers who did not follow recommended precautions developed mild unilateral conjunctivitis following direct conjunctival contact with infected poultry during culling operations.³⁴ When surveyed about their safety and health concerns during this outbreak, responders most often cited eye protection concerns. A survey of Italian poultry workers indicated that only

24.1% of those interviewed always wore protective clothing and washed their hands when working with poultry.³⁵ These studies demonstrate the importance of strict adherence to all recommendations for protecting poultry workers from exposure to HPAI viruses, including providing appropriate PPE and training in its proper use, and ensuring compliance with its proper use. It is also prudent to consider implementing these recommendations during LPAI outbreaks.

The transmission of infection to family members of poultry workers in the Netherlands outbreak in 2003 demonstrates that protection of poultry workers is critical to protecting the public health.³³ Protecting at-risk workers from occupational exposure to AI viruses is an important public health measure to protect workers from potential infection and disease and to prevent the potential transformation of this animal virus into a novel virus that may be more easily transmitted from person to person. The human influenza pandemics of 1957 and 1968 were caused by the reassortment of genes from human and avian viruses.³⁶ Therefore, vaccination of poultry workers against the seasonal influenza viruses is another potentially important public health measure.^{37,38} Vaccinating these workers reduces their risk of dual infection with a seasonal influenza virus and AI virus, preventing possible reassortment and development of a novel human-adapted virus.

CONCLUSIONS

AI viruses are best controlled through international collaborative animal and public health campaigns to prevent, detect, respond to, and control the disease in wildlife, production animals, and humans, including workers. Educating employers and training poultry workers are critical components of worker protection. Other recommendations for protecting poultry workers from HPAI viruses include the use of good hygiene and work practices, personal protective clothing and equipment, vaccination for seasonal influenza viruses, antiviral medication, and medical surveillance. Ensuring worker compliance with protective recommendations is crucial. Recommendations for worker protection must be practical and feasible, and barriers to their implementation should be addressed. More research is needed to develop PPE that is comfortable and easy to use during the highly physical activities or hot conditions that may occur during an AI outbreak. There is a need for impermeable clothing that also has high breathability to reduce heat stress. Each workplace should have an AI response plan that complements local, state, and federal plans. Poultry workers are an important interface between the poultry and human

populations, and protecting these workers is critical to protecting them, their families, their communities, and the public health.

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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