Dead Birds Don't Fly

An Avian Flu Primer for Small-Scale Farmers

20 years

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Avian Flu: A Primer for Small-Scale Farmers

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Published March 2006

Introduction

Avian influenza, or "bird flu," has generated headlines daily for the last several years. It originated in China, spread throughout Asia and has most recently taken roost in Russia, Turkey, Nigeria and France. Bird flu is similar to human flu; they are both caused by viruses and they are both transmitted through coughing, sneezing and by touching something with flu viruses on it and then touching your (or the bird's) mouth or nose. Influenza viruses, whether they infect humans or birds, come in several different types. The specific avian influenza virus that is getting all the attention is H5N1, a highly lethal and contagious virus in domestic poultry. It has decimated entire flocks of several thousand birds in days. And while the high mortality rate among poultry has wreaked economic havoc on the poultry industry in infected countries, bird deaths are not what has the international public health community holding its collective breath. Most avian influenza viruses only infect birds, but H5N1 can also infect humans, and when it does, about half of those infected die. Luckily, it does not infect humans easily and thus while millions of birds have either died of H5N1 infection, or been culled to keep the infection from spreading, only 184 human cases of H5N1 infection have been confirmed. The concern is that, as the H5N1 virus has more contact with humans, it will eventually acquire the ability to easily infect humans and be easily spread between humans. Should it acquire these characteristics, the virus will most likely spark the next flu pandemic.

What does this have to do with small independent poultry farmers, specifically those with free-range or pastured operations, here in the United States? The spread of the virus through Asia was due to human activity—the buying and selling of infected poultry for example. However, no human connection could be found to explain the jump of the H5N1 virus to Russia and Turkey. It has been hypothesized that migratory birds, particularly waterfowl, are responsible for carrying the virus to those countries. These wild birds, while infected, appear healthy. If these same birds come into contact with domestic poultry such as chickens or turkeys, they could transmit the virus to the poultry who could, in turn, infect humans. It is not yet clear if migratory birds are in fact spreading the virus and, at this time, North American bird species have not tested positive for the H5N1 virus. Others have postulated that the disease has spread largely through poorly regulated confined-poultry operations that transport birds around the world through a multitude of channels.[1] The spread of the disease has followed railway lines. Exported Asian chicken manure may have also contributed to the spread.[2]

With the rapid spread of avian flu, there have already been calls for free-range and pastured poultry to be brought inside to prevent contact with wild birds. Austria, Canada, Croatia, France, Germany, the Netherlands, Norway, Slovenia, Nigeria and Sweden all have enacted various outdoor-poultry bans in response to avian flu.[3] At present, it does not appear to be necessary to confine free-range and pastured birds in the U.S. However, this situation may change and free-range and pastured poultry farmers must be ready to take steps to protect their flocks and safeguard public health.

This report is meant to first educate farmers with free-range or pasture poultry operations about the basic biology and epidemiology of avian influenza (AI), both in birds and in humans; and, second, to provide a framework for free-range and pastured poultry farmers to gauge the risk of AI infection in their flocks and to assess the risk of human infection due to contact with sick birds. Specific attention is paid to the H5N1 virus.

Every farm is different and will respond differently. This paper provides only general suggestions to reduce risks for the spread of avian flu, and there is no guarantee that even if all recommendations are followed that avian flu will not appear. But we hope that farmers, with this information in hand, can take steps appropriate to their operation to reduce the risk of infection in flocks and in humans and be able to better represent their interests in local, state and federal planning for AI outbreaks.

Avian influenza 101

Viruses are essentially genes enclosed in a protein coat. The genes contain the genetic material of the virus, while the protein coat protects the genetic material and assists the virus in latching onto and entering a host's (e.g., bird, human) cell. Once inside, the virus hijacks the cell's own machinery to make copies of itself. These copies, or progeny viruses, are eventually released from the original host cell and go on to infect other cells within the host. This replication process often kills the host cell.

Influenza viruses come in three types, denoted A, B and C. Types B and C infect primarily humans and, while they can make humans sick, the illness is typically not severe. Type A can infect all types of mammals, including humans, and birds. Influenza A viruses are further classified according to the hemagglutinin (H) and neuraminidase (N) proteins that are found on their surfaces. Hemagglutinin, the protein that is responsible for binding the virus onto the cell surface, is found in 16 different subtypes in Influenza A viruses. Neuraminidase aids in the release of the virus into a host cell and occurs in nine different subtypes in Influenza A viruses. The subtype that has caused the mass culling of birds in Asia is H5N1. Influenza A viruses are normally seen in only one species. However, they can jump to another species, as we have seen for H5N1 which jumped from poultry to humans. Avian influenza, or "bird flu," refers to those viral subtypes, such as H5N1, that occur mainly in birds. Viral subtypes found mainly in humans are H1N1, H1N2 and H3N2.

Influenza viruses in domestic and wild birds

Avian influenza viruses that have low virulence and cause only mild symptoms in birds are termed "low pathogenic" avian influenza (LPAI). In LPAI, infection is typically confined to the bird's respiratory and intestinal tracks and most birds will eventually fight off this type of infection. Avian influenza viruses with high virulence are termed "highly pathogenic" avian influenza (HPAI). HPAI affects multiple internal organs, spreads rapidly through a flock and has a high (50-100 percent) mortality rate. Waterfowl, particularly ducks, are known to harbor low pathogenic forms of almost all subtypes of influenza A. These birds typically do not exhibit symptoms but can transmit the virus to others and thus are referred to as "carriers." The leading theory is that highly pathogenic H5N1 has emerged through contact between domestic poultry, such as chickens or turkeys, and wild birds. Initially, the virus circulated among domestic poultry flocks in its low pathogenic form, but as it adapted to its new host, the virus acquired the ability to infect the entire body and become highly pathogenic. This process of adaptation is described below under the "Pandemic risk" section.

There are several outbreaks of LPAI in the U.S. every year. LPAI does not pose a serious threat to humans, although LPAI infection of H5 or H7 subtypes are monitored closely because of the propensity for these viruses to mutate into HPAI. Certain strains of HPAI have been known to cause infection in humans that have had direct contact with either sick birds or with material that was in direct contact with sick birds. HPAI outbreaks have occurred three times in the U.S.: 1924, 1983-1984 and 2004.[4] The 1924 outbreak of an H7 virus originated and was isolated at live bird markets on the East Coast. The 1983-1984 outbreak of H5N2 occurred in Pennsylvania and Virginia and originated in flocks raised on large-scale confined poultry farms. To control the outbreak, nearly every chicken in Pennsylvania was killed. In this case, only mild illness in poultry were initially observed. The virus continued to circulate among the flocks and within six to nine months, it had evolved into a highly pathogenic form. The most recent outbreak in the U.S., also due to H5N2, was in Texas in 2004. Outbreaks of HPAI occur elsewhere in the world, most recently in Italy in 1999-2000 (H7N1), in Chile in 2002 (H7N3) and the Netherlands in 2003 (H7N7). In this last case, 89 humans became infected, one of whom died. All those infected had either come into direct contact with sick birds or contaminated materials, or were family members of those with direct contact.[5]

The H5N1 subtype has circulated amongst birds for decades; the first documented outbreak among domestic birds occurred in Scotland in 1959. It was first observed to infect humans in 1997 during an outbreak of HPAI among poultry in Hong Kong. Of the 18 confirmed cases, six died. Another outbreak of H5N1 was reported in Hong Kong in early 2003, with two cases of human infection (one fatality). During the latter part of 2003 and early 2004, there were several large outbreaks of H5N1 among poultry throughout Asia. Affected countries included South Korea, Japan, Indonesia, Vietnam, Thailand, Laos, Cambodia and China. All of these outbreaks were controlled by mass culling of birds, regardless of whether the flocks exhibited symptoms or not. H5N1 outbreaks continue to occur in these countries and have now spread to Malaysia, Russia, Turkey and the Ukraine. Humans continue to be infected during these outbreaks, and as of March 2006, there have been 184 reported human infections, 103 of which have led to death.[6] It should be noted that, with the exception of one possible case of transmission between a daughter and her mother, all cases of human infection have come about through direct contact with infected birds and contaminated material. H5N1 has not been observed in the U.S.

Pandemic risk

An *epidemic* is localized outbreak of a disease. A *pandemic* is an epidemic on a global scale. Epidemics and pandemics occur when a new strain of virus emerges in which humans have very little or no immunity. The human immune system has several different defense mechanisms to fight off infections. The symptoms we typically suffer when we have the flu—fever, cough, runny nose—are actually caused by some of those defense mechanisms. Another way the immune system combats viral infections is the creation of antibodies specifically targeted at the particular virus that has infected the body. Some of the antibodies bind to the H protein on the viral coat and block it from entering the cell. Other antibodies bind to the N protein preventing further spread of the virus. Once an antibody is produced by the immune system, it will be available to fight off any subsequent infections by the same virus. When a virus has a novel combination of H and N proteins, the immune system has to start from scratch and thus it takes longer for the immune system to produce antibodies. An infection is basically a race between viral reproduction and the body's production of antibodies. As we age, it takes longer for antibodies to be produced. This is why influenza is more serious for the elderly.

Novel strains of virus emerge when the viral genome undergoes mutation. The genome of influenza A viruses contains eight segmented genes, one of which codes for the H protein and another which codes for the N protein. The remaining six genes code for other proteins involved with viral replication. All genomes, whether they are viral or human, are essentially instructions that tell the cell which proteins to make. Thus when the virus enters the host cell, the cell's machinery reads the virus' genetic code and produces viral proteins, including the H and N proteins.

There are two ways in which a virus can mutate: antigenic drift and antigenic shift. Antigenic drift refers to small mutations in the two genes coding for the virus's surface proteins (H and N) as a function of time. These mutations occur approximately yearly and lead to small changes in the H and N proteins on the virus' surface. Since the immune system's response depends on these two surface proteins, small changes can make it easier for the virus to evade the immune system. However, since the changes are small, antibodies created for previous infections may be partially effective in blocking the virus' spread. Heavier than normal flu seasons are usually due to antigenic drift. Antigenic drift is also responsible for the change from low pathogenic H5N1 to high pathogenic H5N1 in domestic poultry. One possibility that concerns scientists is that, through the process of antigenic drift, H5N1 could acquire the ability to easily infect humans, become easily transmissible between humans or both.

The other possibility that has scientists even more concerned is viral mutation through the process of antigenic shift. Antigenic shift refers to large changes in the virus' genome due to the swapping of H and N genes with another virus. The process can occur when a host is infected with two different viruses. For example, consider a human infected with H3N2 (a human influenza virus) who is subsequently infected with H5N1. If both viruses are present in the same host cell, there is a small chance that their gene segments could reassort into H5N2. Since these changes are large, the human immune system will probably not recognize this new strain and will have no antibodies to fight off infection. While H5N1 has yet to acquire the ability to infect humans easily, it nonetheless can infect them. When it does, the mortality rate is around 50 percent since humans have little or no acquired immunity to H5N1. Human influenza viruses such as H3N2 are very transmissible between humans but have low mortality rates. The concern is that through the process of antigenic shift, the highly lethal (but not easily transmissible) H5N1 can combine with a viral subtype that is highly transmissible between humans (but not very lethal) to produce a new subtype that is both highly lethal and highly transmissible in humans.

Besides infecting people, H5N1 has been shown to infect swine, although again, not easily. Swine have immune systems similar to humans and are known to be carriers of human influenza viruses. Thus they are also potentially lethal mixing vessels. The likelihood of coinfection (by H5N1 and H3N2 for example) of the same cell and that the viruses reassort (to make H5N2) is small. But when millions of animals and humans are infected with their respective viruses and they live in close proximity to each other, the probability of a rare event happening is no longer negligible. Avian influenza viruses that have made the jump to humans have been implicated in all the human influenza pandemics of the last century.[7] Influenza pandemics typically occur every few decades and the last one, referred to as "Hong Kong flu," occurred in 1968–1969. Recently, scientists found that the 1918–1919 Spanish flu pandemic, which killed at least 20 million worldwide, may have been caused by an H1N1 virus jumping from birds to humans.[8] It would seem that we are due for another pandemic and H5N1 is currently the most likely candidate to spark one.

Spread of avian influenza

The spread of highly pathogenic H5N1 in poultry throughout Asia is almost entirely due to human activity. The virus has been able to travel large distances through the buying and selling of infected birds (both in large shipments and individual birds bought and sold at live bird markets); by hitching a ride on transport equipment (e.g., vehicles, cages, egg crates) or workers' clothing and shoes; and through contact with contaminated manure, soil and litter.[9] H5N1 can survive in cool temperatures in manure for at least three months, and a single gram of manure can contain enough viral material to infect 1 million birds. In water, the virus survives for four days at 72°F and 30 days at 32°F. It can survive indefinitely in frozen poultry meat. Eggs can also harbor the virus. Proper cooking (to 162°F) of poultry meat and eggs will deactivate the virus. Good hygienic practices such as separating raw meat from cooked or ready-to-eat foods (i.e., using different knives and cutting boards) and washing hands after handling frozen or raw meat and eggs will ensure the virus is not spread through food. To date, no human has been infected from properly handled food.[10]

The jump of the virus to western China, Russia, Turkey and France seemed to implicate migratory waterfowl as the carriers of the virus, largely because no direct link to human activity could be found. Another clue that suggested that migratory waterfowl were involved in the spread of the infection was that the large outbreak in Southeast Asia in 2003–2004 coincided with high densities of migratory birds in the same area. Waterfowl such as ducks are known to harbor strains of H5N1 that are highly infectious to domestic poultry but cause no signs of illness in the waterfowl. As these birds migrate, they shed the virus in their feces, thereby contaminating the soil and water of their nesting grounds. If domestic birds share the same water source or are allowed to range over the same ground, they can become infected with the virus.

However, the route H5N1 has taken across the globe has not necessarily followed well-known migratory patterns. In addition, clinically normal wild birds in infected countries have been tested extensively for the currently circulating H5N1 strain and test results have mostly been negative (with the exception of six apparently healthy migratory ducks with the H5N1 virus reported by the University of Hong Kong).[11] In fact, the currently circulating strain kills wild ducks just as easily as it does domestic chickens, so wild ducks cannot be the carriers since dying and moribund birds can't fly. It could be that the current strain has evolved specifically for domestic poultry, whose short lives spent in close quarters require the virus to jump quickly from bird to bird to survive. Wild waterfowl may actually be getting infected via domestic poultry rather than the other way around. Yet another possibility is that some other migratory bird species, even one who spends most of its time on or over land, could be transmitting the virus. At this time, the connection between migratory birds and highly pathogenic H5N1 transmission is patchy and the consensus among scientists seems to be that migratory birds probably play some role, but that human activity continues to be the main mode of transmission.[12] For example, the Nigerian outbreaks are not consistent with bird migration patterns and may have come from the transport of sick birds or bird products. [13]

Given the concerns around H5N1 and given that migratory birds may play a role in its spread, the National Wildlife Health Center has begun strategically sampling migratory birds in Alaska for the virus. Alaska sits at the intersection of several flyways: the East Asia/Australian flyway, the Pacific Americas flyway and the Mississippi Americas flyway.[14] The virus could be transmitted through the intermingling of wild birds from Southeast Asia and North America. Through testing, the U.S. Department of Agriculture hopes to provide advance warning to the wildlife, agriculture and public health communities if migratory birds in North America are found to carry the virus.

Preventing infection

For infection to occur:

1. The virus must be present in sufficient quantities.
2. A reservoir for the virus (e.g., feces) must exist.
3. There has to be a mode of transmission.
4. And there must be a susceptible host.

If any of these is not present, infection cannot occur. The amount of virus required to cause infection depends on the virus subtype itself, although as noted above, a gram of highly pathogenic H5N1 can kill a lot of birds. Places in which the virus can reside, or *reservoirs*, include a bird's feces and respiratory excretions as well as soil and litter that was in contact with a bird's feces or respiratory excretions. Surfaces that have come into contact with bird excretions such as cages, platforms, feeders, vehicles, workers' boots or clothing, may also harbor the virus. Transmission can occur through direct contact between birds, via indirect contact with contaminated material, or via a "vector," such as a rodent or insect. A susceptible host refers to a bird (or human) whose immune system is weakened and thus is unable to fight off the infection.

Free-range and organic poultry have an advantage over their caged-raised counterparts in regards to the vitality of their immune systems. Confined poultry are more stressed due to the large density of other birds, poor ventilation and lack of exercise. Free-range poultry are not subject to those conditions. In addition, they are constantly exposed to low levels of pathogens that naturally reside in the environment and this exposure further strengthens their immune system. Many of the poultry lines employed by free-range farmers have been bred to live outdoors and resist infection.[15,16]

In what follows, we describe general practices that address the first three requirements for infection in poultry: Reducing or eliminating the amount of virus present, reservoirs for the virus and ways for the virus to be transmitted. The fourth requirement, susceptible hosts, has already discussed. We discuss protecting farm workers in the "In the event of an outbreak" section. Although this report focuses on H5N1, the following practices—often referred to as "biosecurity" measures in government and industry literature—reduce the likelihood of infection from other avian influenza viruses and pathogens. All farmers, regardless of how their chickens are raised, cannot entirely eliminate the chance of infection. The most likely route for infection is different for free-range, pastured and confined operations, and will also vary from farm to farm—even farms of the same type. This section is meant to help farmers with free-range and pastured operations determine what the likely routes of infection are for their specific farm and, then, to help them find ways to reduce the likelihood of infection via those routes. There are some routes that free-range and pastured operations may not be able to do much about while confined operations can, and vice versa. Even though the specific implementation of these guidelines will vary from farm to farm, it is still important for free-range and pastured poultry farmers to share their specific biosecurity practices with other free-range and pastured poultry farmers to help everyone raise healthy poultry that are still free-range, pastured or organic. A high density of poultry and poultry farms in the area (within ~1 mile radius) increases the risk of infection for all farms in that area, and thus discussing your practices with other farmers in your area is also recommended.

Infection via people

While H5N1 is not currently present in the U.S., other subtypes of AI are already present in this country and H5N1 may yet arrive on North American shores. Human activity continues to be the main mode of transportation for viruses. Factors that increase the risk of people bringing AI to your farm include:[17]

- Allowing strangers access to areas in which poultry are housed or pastured.
- Farm workers who attend cock fights, work on or visit other poultry farms, own their own flock or own exotic pet birds.

Some ways in which these risk factors might be reduced:

- Ask workers to limit or cease the activities mentioned in the second bullet above. Ask them to notify you if they visit other poultry farms.

- ▷ Since some small farms allow individual customers to pick up their bird(s) on the farm, they have on-site slaughtering. It is recommended that these transactions are carried out in an area of the farm separate from the flock's housing and range. Do not allow customers in areas in which the flock resides.
- ▷ Provide protective clothing—including boots and gloves—to those that visit the flock (including veterinarians).
- ▷ Require farm workers to wear clothes that are kept at, and washed on, the farm. Allowing workers to shower on-farm prior to beginning their work day and before returning home is preferable.
- ▷ Provide baths of disinfectant for boots. A bath prior to the disinfectant to wash off soil and debris should be used. Allow adequate contact time with disinfectant. Rubber boots are easy to wash and may be worn over workers' or visitor's own shoes.

Infection via animals

The most common way to bring disease into a flock is to introduce animals that appear healthy but are actually incubating the virus (the incubation period is usually three to seven days). Only rarely are rodents or insects implicated as the origin of disease in a flock. To reduce the risk of infection from animals, these practices might be employed:

- ▷ Use an "all in/all out" approach to raising a flock. In this approach, once a flock has been in residence, no new animals are added to the flock. The entire flock is removed and brought to market or slaughter at the same time. Before introducing a new flock, all equipment is disinfected and old feed and water are removed. Often a downtime of a couple of weeks is observed between flocks.
- ▷ If the above approach is not feasible for your farm, then isolating new animals for 2-4 weeks before introducing them into the flock is recommended. This should also be done for birds taken to exhibition or birds brought to, but not sold at, live bird markets. Pasture or range them in an area fenced off from the resident flock and provide separate housing. You may want either to use different workers for each group (i.e., resident group and new group) or you may want to change clothes, boots, and gloves when moving between the two groups. Always handle or feed new animals last.
- ▷ Find ways to exclude wildlife, rodents and pets from poultry areas. This is particularly important if you live near a habitat that supports wild waterfowl such as ducks or geese. If possible, make sure your poultry does not share water sources with wildlife.
- ▷ Prevent pest infestations by removing habitat in which rodents and insects thrive such as debris and litter piles on the farm. Develop and employ ways to detect rodent or insect infestations.[18]
- ▷ Do not raise pigs on the same farm. If this is not feasible, then make sure the animals are kept separate from each other. Again you may want to change clothing when moving between the pigs and poultry.

Infection via material

The introduction of contaminated equipment such as vehicles, egg trays, cages, feed scoops, etc., presents another possible entry point for disease.

- ▷ Make sure vehicles are parked away from the poultry house and pasture areas. The wheels of vehicles (even wheelbarrows) that must enter these areas from off-farm should be sprayed with a disinfectant (see notes about boots above). This includes the vehicles of the farmer, his/her family, workers, customers, veterinarians, the cable guy, etc.
- ▷ Be particularly careful when employing outside companies to handle slaughtering, removal of dead birds, transporting of poultry, delivery of feed, etc. Often these companies are employed multiple farms in an area. Ask outside companies to arrive at your farm with disinfected equipment. Require their workers to take the same precautions that your own workers take.
- ▷ If you visit another poultry farm, change clothes and boots before working with your own flock. Avoid loaning or borrowing equipment from other farms, or be sure to disinfect equipment if you must loan or borrow something.
- ▷ Clean and disinfect housing and equipment as often as is feasible (a minimum of several times per year).
- ▷ Porous materials such as wood, cloth and cardboard are difficult to disinfect. Consider the use of synthetic materials for egg crates and cages.

- ▷ Organic material such as dust, down, dander, feed, feathers and manure cannot be disinfected. However, they are reservoirs for viruses. Since removing these materials is not likely to be feasible for free range or pastured operations, try to keep them from accumulating too much in one place.

In the event of an outbreak

Currently, the highly pathogenic H5N1 virus has not been detected in U.S. poultry or wild birds. To minimize the risk of H5N1 entering the U.S. through international trade, the importation of live birds and hatching eggs from H5N1-positive countries is prohibited. In addition, poultry products from those countries must be cooked or processed in accordance with USDA standards prior to importation and all imported birds (including pet birds of U.S. origin) are quarantined and tested for AI before entering the country. The USDA's Animal and Plant Health Inspection Service has increased its monitoring of commercial poultry markets for illegally smuggled poultry and has stepped up agricultural inspections at U.S. ports of entry that handle passengers and cargo from H5N1-positive countries. These restrictions and the absence of H5N1 in North American migratory birds mean that an outbreak of highly pathogenic H5N1 in the U.S. is not imminent. However, that situation may change and free-range and pastured poultry farmers should be prepared to take additional precautions in the event of an outbreak.

Protecting farm workers

As was noted earlier, almost all cases of human infection with H5N1 (and other AI viruses in which humans have been infected) have been attributed to direct contact between humans and infected birds. Human immune systems do not readily recognize most AI viruses and when infection occurs, it is often severe and may lead to death. It is of the utmost importance that those who will come into contact with sick birds protect themselves.

▷ Make sure you and your workers know the signs of HPAI infection in poultry. These include:[19]

  - Sudden increase in deaths in flocks. Death follows initial symptoms quickly. Illness spreads quickly through flocks.
  - Lack of energy and appetite.
  - Drop in egg production; soft, thin or misshapen shells.
  - Swelling of the head, eyelids, comb, wattles and legs. Purple discoloration of the wattles, combs and legs.
  - Sneezing, coughing, nasal discharge, labored breathing.
  - Profuse diarrhea.
  - Weakness or staggering gait. Sick birds often sit or stand in semi-comatose state with heads touching the ground.

▷ If you suspect that your birds have avian influenza, do not hesitate to report it. Call your state veterinarian's, local extension or cooperative's office.

▷ Handling carcasses of infected birds is one of the most common ways for humans to get infected. Farm personnel involved in culling of sick poultry, as well as transporting/or disposing carcasses should wear adequate personal protection equipment such as boots, coveralls, gloves, face masks or respirators, and eye protection.[20,21] (See World Organization for Animal Health Web site in the "Resource" section for humane culling and safe carcass disposal methods. See references indicated in footnotes for guidelines on personal protection equipment such as face masks.)

▷ Washing hands regularly (i.e., using soap and water and washing for 15-20 seconds) goes a long way towards avoiding any virus. Hands should still be washed even if gloves were worn.

▷ It is currently recommended by the World Health Organization and by the Occupational Safety and Health Administration that poultry workers get an annual flu shot to prevent coinfection of H5N1 and human influenza viruses. The Centers for Disease Control and Prevention has also recommended that workers take an antiviral drug daily for the entire time they are in direct contact with infected poultry or contaminated surfaces.[22]

▷ Make sure farm personnel know signs of human AI infection. Monitor farm personnel and ask them to monitor their families for symptoms such as fever, cough, sore throat, eye infections and muscle aches. Infection with avian influenza viruses can also lead to pneumonia, acute respiratory distress, and other severe and life-threatening complications. Make sure health care providers are notified prior to arrival at the clinic or hospital of the possible exposure to an AI virus.

Mass culling and vaccination

If an outbreak of H5N1 occurs, it is most likely that the entire flock will be culled even if the infection is only verified in one bird. This is because "stamping out" policies are considered the most effective method for containing an outbreak. Culling other flocks in the same area may also occur even if there is no verification that the flocks are indeed infected. This scenario is more likely if more than one flock in an area is found to have the virus. Presuming your flock is not one of those that is infected, you may be able to avoid culling by quarantining your birds or testing the birds and then vaccinating them if the test is negative.

Poultry vaccines for H5N1 have been developed and shown to reduce mortality and prevent disease in both chickens and turkeys. Vaccines are meant to stimulate the immune system to produce antibodies for a specific virus. To be fully effective, vaccines must often be administered more than once with a specific amount of time between vaccinations. The number of vaccinations and the timing of them is referred to as a vaccination protocol. Failure to follow the proper protocol can lead to disease or cause the virus to mutate such that the vaccine is no longer effective (similar to bacteria becoming antibiotic-resistant). It takes two to three weeks for a flock to develop a sufficient level of immunity to protect the majority of birds within it. Even if vaccinated, birds can still become infected. But vaccinated birds will produce less of the virus, and consequently release less of the virus into the environment, than unvaccinated birds. The virus-shedding vaccinated birds may appear healthy and thus it becomes difficult to tell if a virus is circulating among the flock. Often a few unvaccinated birds, called "sentinel birds," are kept in to serve as signals for flock infection. Another difficulty is differentiating unvaccinated but infected birds from vaccinated birds since both groups are producing antibodies for the virus, and the test for viral infection is whether antibodies are present or not. One option is vaccinating birds with an H5N2 vaccine rather than an H5N1 vaccine; this way you could distinguish infected, unvaccinated birds from vaccinated birds in the antibody test. Such a strategy, however, will offer only partial immunity to the H5N1 virus since the N proteins don't match.

Given the complexity of vaccination programs and the possible consequences of improperly used vaccines, vaccination programs must be carefully monitored. Culling, consequently, is the preferred method for stopping an outbreak. However, the role of vaccines in responding to—and preventing—an outbreak is a current topic of discussion among scientists and decision-makers.[23] Vaccines could be used in conjunction with culling. For example, an infected flock is destroyed but flocks residing around the infected area are vaccinated. Vaccines might also be used preventively, either in response to specified event (such as a sudden increase in the mortality of wild waterfowl) or as a basic safety measure. At present, the U.S. government has stockpiled various AI vaccines, including one for H5N1,[24] and discussions regarding strategies for their use in the U.S. are ongoing.

If your flock is culled, you have a right to be compensated for it. Where this compensation comes from and the determination of the compensation levels is also being discussed currently among policy-makers.

Conclusion

Avian influenza of the H5N1 subtype is being closely tracked because of its potential to start a new flu pandemic in humans and the significant impact it could have on the poultry industry. H5N1 is currently not in North America due to import bans on poultry and birds from affected countries, and because migratory birds who may be carriers of H5N1 have not shown up on its shores. Presently, if a human pandemic were to start, it would most likely begin elsewhere and H5N1 would arrive in the U.S. via infected airline passengers. Other subtypes of AI are endemic in the U.S. and AI outbreaks among poultry, particularly those of the H5 or H7 types, will continue to pose a health concern to humans and can have severe and long-lasting economic consequences for poultry farmers.

The role of migratory birds in spreading the H5N1 virus is unclear; in the vast majority of cases it has been humans and their activity that have led to the virus' spread to other geographic areas. In addition, the virus has yet to be observed in wild birds in the U.S. Thus requiring poultry to remain indoors because of H5N1 concerns is unwarranted at this time. Small free-range and pastured poultry operations tend to have less traffic on the farm than large, confined operations, which reduces the risk of infection. In addition, free-range birds are generally more resistant to infection than their confined counterparts because of a stronger immune system. However, that does not mean that free-range and pastured poultry farms cannot experience an outbreak of avian influenza. Free-range and pastured poultry farmers should develop "best practices" for raising poultry that reduce the likelihood of AI infection within the context of their respective operations. The prevention guidelines given in this report are meant to serve as a basis for developing these practices.

Farmers should also keep abreast of developments regarding the role of migratory birds in transmitting the virus well as the status of AI vaccines and their use so that they can advocate for their farms and flocks appropriately in the event of an outbreak. It is critical that free-range and pastured poultry farmers, and the organizations that represent them, get involved with planning for AI outbreaks at the local, state and national levels to ensure that the response to those outbreaks does not unduly inflict hardship on free-range and pastured operations but still protects public health.

Glossary

antibodies
Proteins that are either normally present in the body or are produced in response to viral infection. These proteins bind to the viral surface proteins hemagglutinin and neuraminidase and prevent them from latching onto a cell. The production of antibodies is part of the body's immune response.

antigenic drift
Small, gradual changes in the two genes that contain the genetic instructions for producing the main surface proteins of the virus, hemagglutinin and neuraminidase.

antigenic shift
Antigenic shift refers to an abrupt, major change to produce a novel influenza A virus subtype in humans that was not currently circulating among people

biosecurity
Farm practices undertaken to prevent poultry diseases such as avian influenza.

carrier
An animal or human that is infected with a disease and exhibits no symptoms but can transmit the virus to another animal or humans.

confined poultry
A practice for raising poultry in which tens of thousands of birds are raised indoors in cages or in houses. Since they are kept indoors at all times, birds are protected from predators. Nutrition is provided from feed.

free-range poultry
A farming practice that allows birds to range for food freely across pastures, gardens, and/or cropland, and to return at night or in inclement weather to portable housing. Birds are vulnerable to predation.

H5N1
A specific subtype of the influenza A virus found primarily in birds.

hemagglutinin or **H protein**
One of the proteins composing the virus' coat. There are 16 different types of hemagglutinin (denoted H1-H16).

HPAI or **high pathogenic avian influenza**
Avian influenza strains that are extremely contagious and cause severe illness in birds. Most birds die from the illness.

host
A human or animal in which a parasite, such as a virus, lives.

LPAI or **low pathogenic avian influenza**
Avian influenza strains that cause few signs of illness in birds and birds exhibit minor symptoms. Most birds recover from the illness.

neuraminidase or **N protein**
One of the proteins composing the virus' coat. There are nine different types of neuraminidase (denoted N1-N9).

pandemic
A disease or condition that is found in a large part of the population; a global epidemic.

pastured poultry
Poultry raised in in floorless portable pens that are moved daily to fresh pasture. Birds feed on grass, worms, insects, and supplemental grain-based feed.

protein coat
The protective shell around a virus' genetic material. It is made up of the hemagglutinin and neuraminidase proteins and it assists the virus in fusing onto and entering a host's cell.

vaccination protocol
The number of times a vaccine is administered and the timing between successive vaccinations.

virus
A submicroscopic infectious agent that replicates itself only within cells of living hosts such as humans or animals. They are composed of genetic material (DNA or RNA) wrapped in a protein coat.

Resources
The following Web sites have extensive coverage of various aspects of AI. Much of the information presented in this report was drawn from these different sites. They are updated regularly as new events are reported. Regular monitoring of these Web sites and the general news can assist farmers in keeping abreast of AI developments, particularly in the areas of migratory birds and vaccines. Specific references from the text are found in the footnotes.

Animal and Plant Health Inspection Service
aphis.usda.gov/newsroom/hot_issues/avian_influenza.shtml

ATTRA: National Sustainable Agriculture Information Service
attra.org/livestock.html#Poultry

Centers for Disease Control
cdc.gov/flu/avian/

Food and Agriculture Organization of the United Nations
fao.org/ag/againfo/subjects/en/health/diseases-cards/special_avian.html

National Wildlife Health Center
nwhc.usgs.gov/research/avian_influenza/avian_influenza.html

Nature magazine
nature.com/nature/focus/avianflu

The Poultry Site
thepoultrysite.com/features.asp

U.S. Department of Agriculture
usda.gov/wps/portal/usdahome?navtype=SU&navid=AVIAN_INFLUENZA

Wikipedia
en.wikipedia.org/wiki/Avian_influenza

World Health Organization
who.int/csr/disease/avian_influenza/en

World Organization for Animal Health
oie.int/eng/AVIAN_INFLUENZA

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10. World Health Organization. http://www.who.int/foodsafety/micro/avian/en/index.html
11. Avian Influenza: Are Wild Birds to Blame? Dennis Normile. *Science*. 310:426-428 (http://www.sciencemag.com)
12. UN Food and Agriculture Program. http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/avian_HPAIrisk.html
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14. UN Food and Agriculture Program. http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/migrationmap.html
15. National Sustainable Agriculture Information Service. http://www.attra.ncat.org/attra-pub/labelrouge.html#Part1
16. Sustainable Agriculture Research and Education. http://www.sare.org/publications/poultry/index.htm
17. Biosecurity CD from the U.S. Egg and Poultry Association. It is free of charge and can be ordered via the following website: http://www.poultryegg.org/Biosecurity/biosecurity.cfm. While this CD is targeted at confined poultry operations, there is an interactive tool that estimates the risk of infection for various scenarios that may still be useful for free-range and pastured poultry operations.
18. *Ibid*. The CD discusses methods for detecting and controlling pest infestations.
19. U.S. Department of Agriculture. http://www.aphis.usda.gov/vs/birdbiosecurity/hpai.html
20. World Health Organization. http://www.who.int/csr/disease/avian_influenza/guidelines/Avian%20Influenza.pdf
21. U.S. Department of Labor. http://www.osha.gov/dts/shib/shib121304.html
22. U.S. Center for Disease Control. http://www.cdc.gov/flu/avian/professional/protect-guid.htm
23. UN Food and Agriculture Organization. http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/27septrecomm.pdf
24. U.S. Department of Agriculture. http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?contentidonly=true&contentid=2005/10/0461.xml

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