

Highly Pathogenic Avian Influenza

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**Avian Influenza
(Highly Pathogenic)**


Fowl plague, Fowl pest, Peste aviaire, Geflugelpest,
Typhus exudatious gallinarium, Brunswick bird plague,
Brunswick disease, Fowl disease, Fowl or bird grippe

Last Updated: May 2008
Disease from highly pathogenic avian influenza is also known as fowl plague, fowl pest, peste aviaire, geflugelpest, typhus exudatious gallinarium, Brunswick bird plague, Brunswick disease, fowl disease, fowl or bird grippe.

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Overview

- Organism
- Economic Impact
- Epidemiology
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control
- Actions to take



Center for Food Security and Public Health, Iowa State University, 2008

In today's presentation we will cover information regarding the organism that causes highly pathogenic avian influenza virus and its epidemiology. We will also talk about the economic impact the disease has had in the past and could have in the future. Additionally, we will talk about how it is transmitted, the species it affects, clinical and necropsy signs seen, as well as diagnosis and treatment of the disease. Finally, we will address prevention and control measures for the disease and actions to take if highly pathogenic avian influenza virus is suspected.

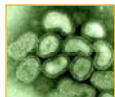
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The Organism

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Influenza Virus

- Family Orthomyxoviridae
 - "myxo" means mucus
- Three main types
 - Type A
 - Multiple species
 - Type B
 - Humans
 - Type C
 - Humans and swine



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Influenza viruses belong to the family *Orthomyxoviridae*. They are classified into three main types. Influenza type A viruses affect multiple species. Influenza types B and C both infect humans, but type C is also known to infect swine. We will discuss each of these further in the next few slides. (Photo: ISU-FAD course section by Dr. Corrie Brown)

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Influenza A

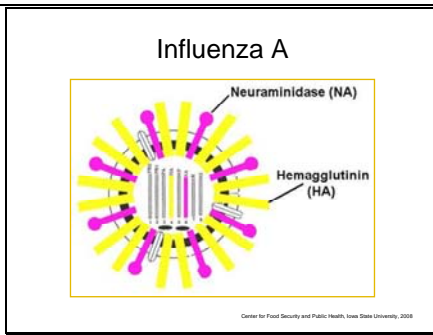
- Multiple species
 - Humans, pigs, horses, birds, others
- Most virulent group
- Classification by surface antigens into subtypes
 - Hemagglutinin (H or HA)
 - Neuraminidase (N or NA)

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Influenza type A infects multiple species. Several human influenza strains are type A while all avian strains are type A. They are considered the most virulent group, although not all strains cause clinical disease. Type A influenza viruses are classified into subtypes based on two surface antigens known as hemagglutinin (H) and neuraminidase (N), sometimes also referred to as HA and NA respectively.

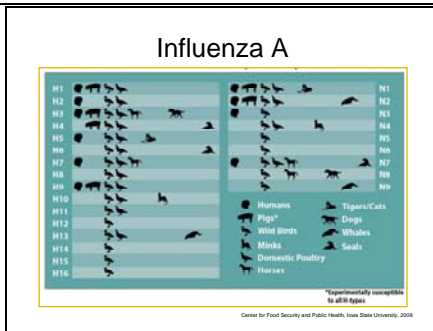
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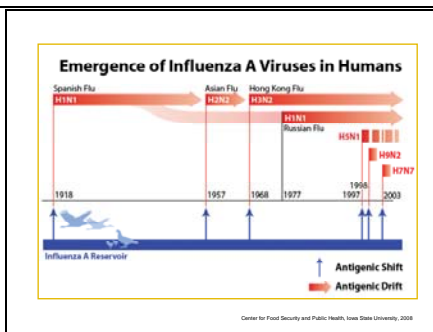
This picture depicts the major antigenic components of the influenza A virus. The virus is composed of eight segments of RNA. Having segments makes it easier for reassortment to occur. The yellow bars represent the hemagglutinin (HA) part of the virus. The pink protrusions represent neuraminidase (NA).

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Influenza A viruses infect a variety of species. This shows that all the H and all the N types are found in the waterfowl and shorebird reservoir. Human infections that occur yearly are most often the result of H1N1, H3N2, and H1N2 influenza A viruses. Human infections by other subtypes are sporadic, have not sustained human to human transmission, and are rare to date. Avian influenza viruses of most concern to the poultry industry are the H5 and H7 subtypes. These two subtypes are associated with high pathogenicity in domestic poultry. These viruses are of concern to human public health also because they have infected and caused serious disease in humans. Although the infections have been rare they are concerning because the human population is immunologically naïve to those subtypes. [Graphic by Travis Engelhaupt, CFSPH, ISU, CVM]

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In the 20th century there were three human influenza pandemics, the greatest being the 1918 Spanish Flu pandemic. Each pandemic was caused by an antigenic shift (change in H type). The human population was immunologically naïve to each of these new subtypes. The source of the pandemic viruses were:

- 1918 – Avian (all 8 genes)
- 1957 – Reassortant virus. Five of the influenza genes were from circulating human influenza and 3 genes (including the H and the N) were from avian influenza
- 1968 – Reassortant virus with 6 genes from the circulating human influenza virus and 2 genes (including the H gene) from avian influenza.
- 1977 – This virus was very similar to an H1N1 influenza virus isolated in the 1950s. Some scientists think this may have been introduced from a laboratory frozen source.

The human population has had periodic influenza pandemics and this is expected to continue. The World Health Organization is on the lookout for the next virus that might cause a human pandemic. The infections of humans on the right side of the graph are being watched and surveillance has increased to quickly detect any change in this virus that would indicate a possible human pandemic virus has emerged. This is why the H5N1 avian influenza outbreak in birds is getting so much attention. [Graphic by Travis Engelhaupt and Clint May, CFSPH]

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Influenza B

- Mostly humans
- Common
- Less severe than A
- Epidemics occur less often than A
- Human seasonal vaccine
 - Two strains of type A
 - One strain of type B

Influenza type B viruses infect mostly humans. They are not categorized into subtypes. They are quite common, but clinical disease is usually less severe than influenza A. Epidemics do occur, but are seen less often than type A. Human seasonal vaccines usually contain two strains of influenza A and one strain of B.


Highly Pathogenic Avian Influenza

S l i d e 1 0	<h2>Influenza C</h2> <ul style="list-style-type: none"> • Humans and swine • Different pattern of surface proteins • Rare <ul style="list-style-type: none"> – Mild to no symptoms • By age 15, most have antibodies <p style="font-size: small; text-align: center;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Influenza type C has been identified in both humans and swine. Their pattern of surface proteins are different than the other influenza's and are not categorized into subtypes. They are rare and usually produce mild or no clinical symptoms. It has been found that most individuals have antibodies to influenza C by the age of 15.</p>
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S l i d e 1 1	<h2>Avian Influenza</h2> <ul style="list-style-type: none"> • Disease based on genetic features and/or severity of disease in poultry <ul style="list-style-type: none"> – Low pathogenic AI (LPAI) <ul style="list-style-type: none"> • H1 to H16 subtypes – Highly pathogenic AI (HPAI) <ul style="list-style-type: none"> • Some H5 or H7 subtypes • LPAI H5 or H7 subtypes can mutate into HPAI <p style="font-size: small; text-align: center;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Avian influenza only includes type A viruses and described based on their pathogenicity. Genetic features and/or severity of disease in poultry determines whether the virus is classified as low pathogenic (LPAI) or high pathogenic (HPAI) avian influenza. Low pathogenic avian influenza (LPAI) includes viruses in all H1 to H16 subtypes. On the other hand, highly pathogenic avian influenza (HPAI) have traditionally been either H5 or H7 subtypes. H5 and H7 LPAI viruses do exist and are of concern because they can mutate into a HPAI.</p>
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S l i d e 1 2	<h2>Importance</h2>	
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S l i d e 1 3	<h2>History</h2> <ul style="list-style-type: none"> • 1878: First identified case in Italy • 1924-25: First U.S. cases • Mildly pathogenic avian influenza first identified mid-twentieth century • 1970's <ul style="list-style-type: none"> – Migratory waterfowl carriers – Outbreaks in mink, seals and whales <p style="font-size: small; text-align: center;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Avian influenza was first identified in Italy in 1878. The first US cases of highly pathogenic avian influenza (HP AI) were reported in the U.S. in 1924-25 and 1929. Quarantine, depopulation, cleaning and disinfection were used to eradicate HP AI from the United States. Milder disease caused by AI viruses were recognized in the middle of the twentieth century. Today these AI viruses are termed non-highly pathogenic or mildly pathogenic, designated MP AI. In the 1970's surveillance for Newcastle disease virus showed that migratory waterfowl were asymptomatic carriers of AI. Since then it has been shown that wild waterfowl (especially ducks and geese) and other aquatic birds are the original reservoir of all influenza viral genes. Avian influenza viruses have caused epizootics of respiratory disease in mink, seals and whales. (Photo: US FWS)</p>
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S l i d e 1 4	<h2>Economic Impact</h2> <ul style="list-style-type: none"> • Direct losses: <ul style="list-style-type: none"> – Depopulation and disposal – High morbidity and mortality – Quarantine and surveillance – Indemnities • 1978-1996: Seasonal outbreaks in Minnesota cost taxpayers \$22 million  <p style="font-size: small; text-align: center;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Economic losses from avian influenza vary depending on the strain of virus, species of bird infected, number of farms involved, control methods used and the speed of implementation of control or eradication strategies. Direct losses include depopulation and disposal costs, high morbidity and mortality losses, quarantine and surveillance costs and indemnities paid for elimination of birds. In most developed countries, HP and MP AI have not been endemic diseases in the commercial poultry industries. Mildly pathogenic AI outbreaks have caused significant economic losses. Losses from seasonal outbreaks of MP AI in Minnesota between 1978 and 1996 cost a total of \$22 million US. (Photo: ISU-FAD course section by Dr. Corrie Brown)</p>
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Economic Impact

- 1983: U.S. outbreak (H5N2)
 - \$65 million in losses
 - Destruction of 17 million birds
 - 30% increase in egg prices
- 1999-2000: Italy outbreak (H7N1)
 - \$100 million in compensation to farmers
 - 18 million birds destroyed
 - Indirect losses of \$500 million


Center for Food Security and Public Health, Iowa State University, 2008

The 1983 outbreak of HP AI (H5N2) in the northeastern United States resulted in losses of nearly \$65 million, the destruction of more than 17 million birds, and a 30% increase in retain egg prices. In the 1999-2000 outbreak of HP AI (H7N1) in Italy the government paid farmers \$100 million (U.S.) in compensation for 18 million birds with total indirect losses at \$500 million.

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Economic Impact

- 1997: Hong Kong outbreak (H5N1)
 - \$13 million for depopulation and indemnities
 - 1.4 million birds
- 2001: Hong Kong outbreak (H5N1)
 - 1.2 million birds
 - \$3.8 million
- 2003: European outbreak (H7N7)
 - 30 million birds destroyed
 - \$314 million



Center for Food Security and Public Health, Iowa State University, 2008

The 1997 outbreak of HP AI (H5N1) in Hong Kong live poultry market cost \$13 million U.S. for depopulation and indemnities for 1.4 million birds. The 2001 outbreak, also in Hong Kong cost \$3.8 million dollars and 1.2 million birds were destroyed. The 2003 European outbreak of (H7N7) strain has resulted in the destruction of 30 million birds, at the cost of \$314 million. (Photo: USDA)


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Epidemiology

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Geographic Distribution

- Worldwide distribution
- Reservoir
 - Free flying aquatic birds: Ducks, geese, shorebirds, gulls, terns, auks
- Outbreaks worldwide now
- Similarity to Newcastle Disease makes actual distribution difficult to define
- Altered avian ecosystems have created new niche for AI viruses





Center for Food Security and Public Health, Iowa State University, 2008

Avian HPAI viruses have been eradicated from domesticated poultry in most developed nations, but reservoirs for these viruses occur worldwide in wild birds. An outbreak of highly pathogenic avian influenza can occur in any country, due to the transmission of avian influenza viruses from these reservoirs into poultry. The most frequent source of AI viruses has been free flying aquatic birds, ducks, geese, and shorebirds, gulls, terns and auks, which are considered the genetic reservoirs of all AI viruses. Because laboratory facilities are not readily available in some parts of the world to differentiate Newcastle disease from HPAI, the actual incidence of HPAI in the world's poultry is difficult to define. Humans have altered the natural ecosystems of birds through captivity, domestication, industrial agriculture, and nontraditional raising practices. This has created new niches for AI viruses and caused a change in the incidence and distribution of AI infections.

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Epidemiology: Birds

- Initial source of infection
 - Migrating ducks or other waterfowl
- Spread by aerosol, shared drinking water, fomites
 - To other migratory waterfowl, domestic poultry and pigs, pet birds
- Virus found in respiratory secretions and feces

Center for Food Security and Public Health, Iowa State University, 2008


Migratory waterfowl are widely considered to be the reservoirs of avian influenza virus. Feces and respiratory secretions contain large amounts of virus, which can infect a new host through the conjunctiva or respiratory tract. Avian influenza virus can spread by aerosols when birds are in close proximity, and might also be transmitted through shared drinking water. The virus appears to be present in eggs laid by infected hens, but they are unlikely to survive and hatch. Fomites and infected birds can transmit the disease between flocks. In one outbreak in Pennsylvania, the virus may have been spread by garbage flies. Airborne dissemination may be possible as well as movement of infected poultry. In experimental studies AI viruses can be excreted in the feces and maintained in the environment and can re-emerge after a significantly stressful event. Once a flock is infected, it should be considered a potential source of virus for life.

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Epidemiology: Pigs

- Susceptible to infection with all subtypes of avian influenza A
 - Called a “mixing vessel”
- Receptors for both avian and human influenza virus
- In US H1N1 stable for almost 30 years
- Now H1N1, H3N2, H1N2



Center for Food Security and Public Health, Iowa State University, 2008

Pigs have also been infected with avian influenza viruses. One of the concerns with this, is that pigs have receptors for both avian and human influenza viruses (as well as swine influenza viruses). Pigs can serve as “mixing” vessels for these various subtypes and serve as a site for genetic reassortment (or “mixing”) of these viruses. The alterations may develop a novel virus more virulent or transmissible than the original subtypes.

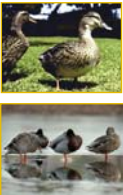
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Transmission

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Animal Transmission

- Initial source of infection
 - Other poultry, migratory waterfowl, domestic pigs, pet birds
- Spread by aerosol, shared drinking water, fomites
- Virus in respiratory secretions and feces
- Virus present in eggs but eggs unlikely to survive and hatch



Center for Food Security and Public Health, Iowa State University, 2008

Migratory waterfowl are widely considered to be the reservoirs of avian influenza virus. Feces and respiratory secretions contain large amounts of virus, which can infect a new host through the conjunctiva or respiratory tract. Avian influenza virus can spread by aerosols when birds are in close proximity, and might also be transmitted through shared drinking water. The virus appears to be present in eggs laid by infected hens, but they are unlikely to survive and hatch. Fomites and infected birds can transmit the disease between flocks. In one outbreak in Pennsylvania, the virus may have been spread by garbage flies. Airborne dissemination may be possible as well as movement of infected poultry. In experimental studies AI viruses can be excreted in the feces and maintained in the environment and can re-emerge after a significantly stressful event. Once a flock is infected, it should be considered a potential source of virus for life.

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Human Transmission

- Previously considered non-pathogenic for humans
- 1997, Hong Kong
 - 18 humans infected, 6 died
 - H5N1 virus linked to outbreak in live bird market and area farms
- 2003, the Netherlands
 - 83 confirmed cases in humans, 1 death
 - H7N7 strain
- Swine are proposed “mixing vessel”

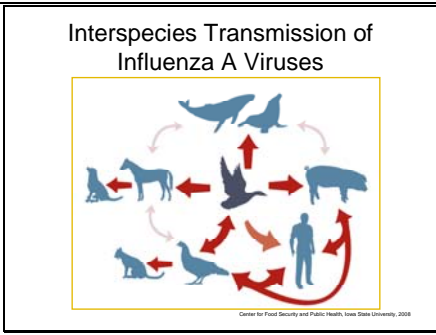
Center for Food Security and Public Health, Iowa State University, 2008

AI viruses were once thought to be nonpathogenic for humans until 1997 when 18 people were infected and six people died from a highly pathogenic H5N1 strain avian influenza virus in Hong Kong. The virus was linked to birds in a live bird market and on farms that were experiencing an outbreak of HP AI. An outbreak in the Netherlands in early 2003 resulted in 83 cases of confirmed Avian Influenza in humans. A 57 year old veterinarian who visited a poultry farm affected by the H7N7 strain died in April of acute respiratory distress syndrome and H7N7 was isolated from the patient. Swine have been proposed as a “mixing” vessel for co-infection by influenza viruses from birds and influenza viruses from mammals which develop into new strains (reassortments) that have the ability to infect people and other mammals. Sporadically cases of the transmission of entire AI viruses to humans have occurred but such cases are very rare compared to the hundreds of millions of human infections by human-adapted influenza viruses that occur each year and during pandemics.

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This diagram demonstrates the interspecies transmission of influenza A viruses and is adapted . The red arrows are direct transmissions that have occurred and caused disease. The pink arrows have not occurred but give the picture a very circular look which is consistent with the ecology of this virus. Influenza A viruses seem to be able to cross species barriers if given the right opportunity. The center of all this is the wild waterfowl, the reservoir species. [Note to speaker: Below is a brief description of each species. There is information later in the presentation on each of these so you may want to wait until then to give more information. However, if you are focusing on one species you can delete the later slides and briefly mention them on this slide.]

Influenza A has caused disease in seals and whales (separate outbreaks with different viruses). The viruses appeared to have been transmitted from wild waterfowl.

Equine influenza may have origins from wild waterfowl also. The virus has adapted to the equine host and circulates in that population. The H3N8 of US equine appears to have been transmitted to dogs in January of 2004. This virus has apparently adapted to its new host. In the summer of 2005 it was spread between dogs across the US. It was most prominent in racing dogs but there were cases in pet dogs also. It remains to be determined if the virus will continue to circulate in this species.

Wild waterfowl are often responsible for transmission of the virus to domestic poultry.

The HPAI H5N1 Asian influenza virus infected cats. Zoo cats fed infected uncooked poultry meat became infected and some domestic pet cats that were feeding on a pile of infected dead chickens became infected. The virus did not spread in cats outside of those two outbreaks.

The “mixing vessel” pig can be infected by influenza viruses from wild waterfowl, humans, and domestic poultry. Influenza from swine has been transmitted to humans and caused disease. Human influenza virus has infected pigs. Some of the swine influenza viruses circulating and causing disease in the US swine population contain human influenza genes.

Influenza virus from domestic poultry has sporadically infected and caused severe disease in humans, especially highly pathogenic strains. The first documented case of influenza transmitting directly from bird to human was in 1997. This is discussed later in the presentation.

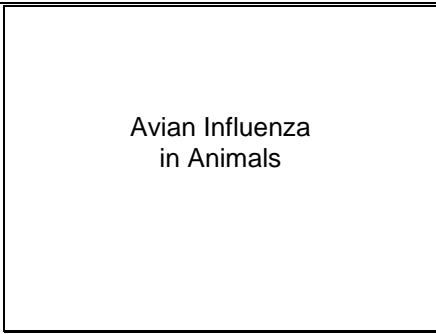
There have been no reports of direct transmission to human from wild waterfowl reservoir hosts.

The next slide shows the many different influenza subtypes and some of the species that have been infected.

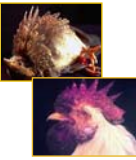

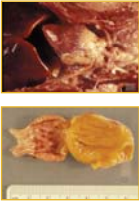

[Graphic by Clint May, CFSPH, ISU, CVM - Adapted from Fields Virology, 4th edition, Lippincott Williams & Wilkins, page 1538]

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Highly Pathogenic Avian Influenza

S I I d e 2 6	<h3 style="text-align: center;">Avian Influenza</h3> <ul style="list-style-type: none"> • Incubation period: 3-14 days • Birds found dead • Drop in egg production • Neurological signs • Depression, anorexia, ruffled feathers • Combs swollen, cyanotic • Conjunctivitis and respiratory signs  <p style="text-align: center; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Incubation period is from 3-14 days and is dependent on the dose of virus, the route of exposure, the species exposed. Some birds are found dead prior to observance of any clinical signs. There may be neurological signs and reduction in normal vocalizations. Depression is common as is a precipitous drop in egg production. Respiratory signs are less prominent but can include rales, sneezing and coughing. In mature chickens, the combs and wattles are often swollen and may be cyanotic. Conjunctivitis, edema of the head and neck, coughing, sneezing and nasal discharge may also be seen. Egg production in hens stops; the last eggs laid often have no shells. Death is common, but severely affected hens occasionally recover. (Photos: ISU-FAD course by Dr. Corrie Brown, showing a dead bird [top] and cyanotic comb and wattles [bottom].)</p>
S I I d e 2 7	<h3 style="text-align: center;">Post Mortem Lesions</h3> <ul style="list-style-type: none"> • Lesions may be absent with sudden death • Severe congestion of the musculature • Dehydration • Subcutaneous edema of head and neck area  <p style="text-align: center; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Lesions may be absent in the case of sudden death. There may be severe congestion of the musculature and dehydration. Subcutaneous edema may be present on the head and neck area. (Photo ISU-FAD course section by Dr. Corrie Brown, shows facial edema)</p>
S I I d e 2 8	<h3 style="text-align: center;">Post Mortem Lesions</h3> <ul style="list-style-type: none"> • Nasal and oral cavity discharge • Petechiae on serosal surfaces • Kidneys severely congested • Severe congestion of the conjunctivae  <p style="text-align: center; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>During necropsy, excessive fluid can flow from the nares and oral cavity. Petechial hemorrhages may be found on serosa and in the body cavity. The kidneys are often severely congested and occasionally plugged with white urate deposits. In young birds and birds with peracute disease, the only significant lesions may be dehydration and severe congestion of the muscles. [Top photo: Numerous epicardial petechiae – Dr. D. Swayne, USDA; Bottom photo: Multiple hemorrhages on the mucosal surface of the proventriculus – Dr. D. Swayne, USDA]</p>
S I I d e 2 9	<h3 style="text-align: center;">Avian Influenza in Cats</h3> <ul style="list-style-type: none"> • H5N1 avian influenza in Asia infected cats fed infected dead chickens • H5N1 experimentally <ul style="list-style-type: none"> – Respiratory – Systemic disease – Transmits cat to cat  <p style="text-align: center; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>The Asian avian H5N1 virus was isolated from sick zoo cats and domestic cats. In both cases, the cats had been fed dead, raw chickens infected with H5N1. Further investigation of H5N1 in cats determined that cats experimentally infected with Asian H5N1 avian influenza virus developed systemic disease (not just respiratory) and the virus was transmitted from cat to cat.</p>
S I I d e 3 0	<h3 style="text-align: center;">Sampling</h3> <ul style="list-style-type: none"> • Before collecting or sending any samples, the proper authorities should be contacted • Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease • HP AI samples may be zoonotic <p style="text-align: center; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease. Some isolates of the avian influenza virus may be zoonotic; samples should be collected and handled with all appropriate precautions.</p>

Highly Pathogenic Avian Influenza

S I d e 3 1	<p style="text-align: center;">Diagnosis</p> <ul style="list-style-type: none"> • Clinically indistinguishable from virulent Newcastle Disease (END) • Suspect with: <ul style="list-style-type: none"> – Sudden death – Drop in egg production – Facial edema, cyanotic combs and wattles – Petechial hemorrhages • Virology and serology necessary for definitive diagnoses <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Highly Pathogenic Avian Influenza (HP AI) is clinically indistinguishable from virulent Newcastle Disease. HP AI should be suspected when severe depression, inappetence, and a drastic drop in egg production are followed by sudden deaths in the flock. Facial edema, swollen and cyanotic combs and wattles, and petechial hemorrhages on the internal organs support this diagnosis. Because of the broad spectrum of signs and lesions a definitive diagnosis must be made by virology and serology.</p>
S I d e 3 2	<p style="text-align: center;">Differential Diagnosis</p> <ul style="list-style-type: none"> • Virulent Newcastle disease • Avian pneumovirus • Infectious laryngotracheitis • Infectious bronchitis • Chlamydia • Mycoplasma • Acute bacterial diseases <ul style="list-style-type: none"> – Fowl cholera, <i>E. coli</i> infection <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Differentials for Highly Pathogenic Avian Influenza include Newcastle disease virus, which is clinically indistinguishable from HP AI; avian pneumovirus and other paramyxoviruses, infectious laryngotracheitis, infectious bronchitis, chlamydia, mycoplasma and other acute bacterial diseases including fowl cholera and <i>E. coli</i> infections.</p>
S I d e 3 3	<p style="text-align: center;">Diagnosis</p> <ul style="list-style-type: none"> • Laboratory Tests <ul style="list-style-type: none"> – HP AI is usually diagnosed by virus isolation • Presence of virus confirmed by <ul style="list-style-type: none"> – AGID – ELISA – RT-PCR • Serology may be helpful <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>Avian influenza is usually diagnosed by virus isolation. The presence of virus can be confirmed by agar gel immunodiffusion (AGID) tests, ELISA or reverse-transcription polymerase chain reaction (RT-PCR) tests. Highly pathogenic strains are identified by their lethality in susceptible chickens and by molecular considerations. Serology can also be helpful in diagnosis and ELISA and AGID tests are available. However, not all species of birds make precipitating antibodies. Hemagglutination inhibition tests are also used, but are subtype specific and may miss some infections.</p>
S I d e 3 4	<p style="text-align: center;">Treatment</p> <ul style="list-style-type: none"> • No specific treatment • Supportive care and antibiotics for secondary infections • Antivirals (amantadine) effective in reducing mortality <ul style="list-style-type: none"> – Not approved in food – Results in resistant  <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2008</p>	<p>No practical, specific treatment exists for avian influenza virus infections in commercial poultry. Supportive care and antibiotic treatment have been used to reduce the effects of concurrent bacterial infections. Amantadine has been shown experimentally to be effective in reducing mortality but the drug is not approved for food animals and quickly results in amantadine resistant viruses. Amantadine hydrochloride, and other antivirals have been licensed for use in humans to treat influenza since 1966. The medication is effective in reducing the severity of influenza Type A in humans. (Photo: ISU-FAD course section by Dr. Corrie Brown)</p>
S I d e 3 5	<p style="text-align: center;">Avian Influenza in Humans</p>	

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Clinical Signs in Humans

- 1997: Hong Kong (H5N1)
 - Fever, respiratory, vomiting, diarrhea, pain
 - Fatal cases: severe bilateral pneumonia, liver dysfunction, renal failure, septic shock
- 1979: MP AI in harbor seals (H7N7)
 - Conjunctivitis

Center for Food Security and Public Health, Iowa State University, 2008

The 1997 Hong Kong outbreak resulted in hospitalization of 18 people and 6 deaths in Hong Kong. The patients had fever, upper respiratory and gastrointestinal disease including vomiting, diarrhea and pain. The patients that died had severe bilateral pneumonia with other complications of liver dysfunction, renal failure, septic shock and pancytopenia. In 1979, a MP AI virus caused an outbreak of respiratory illness and death in harbor seals in northeastern U.S. Self-limiting conjunctivitis was reported in workers handling the seals during the outbreak.

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Clinical Signs in Humans

- 2003: Netherlands (H7N7)
 - Conjunctivitis
 - Mild influenza or respiratory symptoms
 - Fatal case: Acute respiratory distress syndrome

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The H7N7 outbreak in the Netherlands in 2003 resulted in 83 confirmed cases of avian influenza in humans. The most common clinical signs included conjunctivitis and/or mild influenza or respiratory signs. The veterinarian who died after visiting a poultry farm died of acute respiratory distress syndrome.

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Avian Influenza in Humans

- Risk is low
- Strains vary in ability to infect humans
- Close contact with infected birds
 - High occupational exposure, cultural practices may increase risk
- April 2008: 31 cases, 24 deaths

Year	Cases	Deaths
2003	4	4
2004	46	32
2005	98	43
2006	115	79
2007	88	59

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Generally the risk for infection with AI is low. Strains vary in their ability to transmit and infect humans. In the 1983-4 US outbreak and the 1999-2000 outbreak in Italy, individuals with high occupational exposure showed lack of virus infection and lack of serum antibody against it. But the 1997 outbreak in Hong Kong indicated that infection was much more widespread in people with high occupational risk, such as poultry workers. Most of the human infections in the 2003 outbreak resulted from non-compliance with personal bio-safety measures such as wearing gloves, gowns and masks. There was also evidence of transmission from poultry workers to family members. This outbreak emphasizes the need for continuing cooperation between the public health and veterinary medical communities in controlling diseases with a zoonotic potential. Information obtained May 31, 2007 from http://www.who.int/csr/disease/avian_influenza/country/cases_table_2007_05_31/en/index.html

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H5N1 AI in Poultry, Birds since 2003

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This map represents the areas reporting confirmed occurrences of H5N1 avian influenza in poultry and wild birds since 2003 (as of April 14, 2008). Orange represents areas reporting occurrences in poultry, yellow reflects areas reporting occurrences only in wild birds. Map from World Health Organization at http://gamapservr.who.int/mapLibrary/Files/Maps/Global_SubNat_H5N1inAnimalConfirmedCUMULATIVE_20080414.png.

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Prevention and Control

Highly Pathogenic Avian Influenza

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Recommended Actions

- Notification of Authorities
 - Federal:
Area Veterinarian in Charge (AVIC)
 - www.aphis.usda.gov/vs/area_offices.htm
 - State veterinarian
 - www.aphis.usda.gov/vs/sregs/official.htm
- Quarantine


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Due to the economically devastating nature of this disease, authorities should be notified immediately of any suspicious cases of highly pathogenic avian influenza. While waiting for the authorities or a confirmed diagnosis, all suspect animals should be quarantined.

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Recommended Actions

- Confirmatory diagnosis
- Depopulation may occur
 - Infected premises
 - Contact-exposed premises
 - Contiguous premises



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Should highly pathogenic avian influenza be confirmed by diagnosis, depopulation may need to occur. Depopulation protocols include plans for the infected premises, contact-exposed premises, and contiguous premises. Proper destruction of all exposed cadavers, litter and animal products are required. (Photo: USDA-APHIS 2002-2003 California END outbreak)

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Control and Eradication

- Eliminate insects and mice
- Depopulate flock and destroy carcasses
- Remove manure down to bare concrete
- High pressure spray to clean equipment and surfaces
- Spray with residual disinfectant



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To control an outbreak of HP AI the premises must be thoroughly cleaned and disinfected. Insects and mice on the premises should be eliminated, then the flock depopulated and the carcasses destroyed by burying, composting, or rendering. Once the virus have been killed, the manure and feed should be removed down to a bare concrete floor. If the floor is earthen, one inch or more of soil should also be removed. The manure can be buried at least 5 feet deep. It may also be composted for 90 days or longer, depending on the environmental conditions. The compost should be tightly covered with black polyethylene sheets to prevent entry of birds, insects, and rodents. Feathers can be burned; alternatively, they may be removed and the area wet down with disinfectant. High pressure spray equipment should be used to clean all equipment and building surfaces. Once all surfaces are clean and free of all organic material, the entire premises should be sprayed with an approved residual disinfectant. Cresylic or phenolic disinfectants are usually effective. (Photos: USDA-APHIS 2002-2003 California END outbreak-photo illustrates some of the difficulty in cleaning and disinfecting backyard operations)

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Prevention

- Appropriate biosecurity
 - Control human traffic
 - Introduction of new birds into flock
 - Avoid open range rearing in waterfowl prevalent areas
- Education of the poultry industry
- Prompt response to MP AI outbreaks

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The practice of accepted sanitation and biosecurity procedures in poultry operations is of the greatest importance in the prevention, control and eradication of HP AI. In areas where waterfowl, shorebirds or sea birds are prevalent, the rearing of poultry on open range is incompatible with a sound AI prevention program. Appropriate biosecurity practices should be applied, including the control of human traffic and introduction of birds of unknown disease status into the flock. One critical goal of prevention and control is the education of the poultry industry regarding how the virus is introduced, spread and how it can be prevented. HP AI can emerge from MP AI outbreaks so prompt response to MP AI outbreaks is important.

Highly Pathogenic Avian Influenza

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Vaccination of Poultry

- Emergency situations
 - Preserve breeding stock
- Vaccines
 - Killed and fowl-pox vectored
 - DIVA – Differentiating Infected from Vaccinated Animals
- US Vaccine bank with 40 mil doses
 - 20 million for H5
 - 20 million for H7

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The USDA has a vaccine bank with 40 million doses of vaccine for poultry. Twenty million doses are for protection against an H5 avian influenza virus and 20 million doses are for protection against H7 avian influenza viruses. The vaccine would only be used in an emergency situation especially to preserve breeding stock. This vaccine bank is being expanded.

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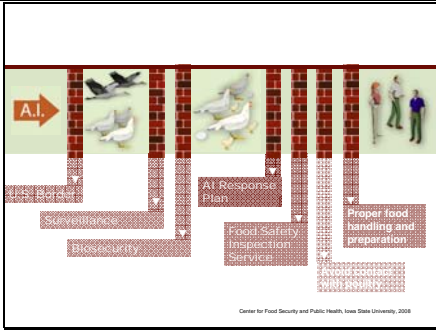
USDA Prevention Activities

- Import restrictions
 - No live birds or bird products from infected countries
- Increasing surveillance of wild birds
- National H5 and H7 control program
- Training for disease recognition
- Improving diagnostics for rapid detection

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Many prevention and control activities are occurring in the US. The USDA has import restrictions on birds and bird products. No live birds or bird products are imported from countries with HPAI. Humans that have traveled to areas where H5N1 infections are occurring are not allowed on a US poultry farm for at least 7 days after return to this country. Introduction of H5N1 HPAI by migratory wild birds or intentional introduction will not be stopped by the border controls and effort is therefore focused on rapid detection. USDA along with the Department of the Interior have increased surveillance of the migratory wild bird population. The USDA has also increased surveillance at live bird markets. There is a National Poultry Improvement Plan (NPIP) AI Surveillance program for layer and breeder flocks of poultry in the US. Under this plan layer and breeder bird flocks are routinely tested for AI. Many broiler flocks are also under surveillance for AI although the current NPIP AI surveillance plan does not include broilers. There is a NPIP AI surveillance plan for broiler flocks in the final stages of approval. This will increase the likelihood of early detection of an AI virus in the US poultry. Other prevention and control activities include training for veterinarians, laboratorians and poultry workers to recognize the disease and improved rapid diagnostics. The veterinary laboratories have formed the National Animal Health Laboratory Network to quickly share information and reagents. USDA is also supporting collaboration and influenza research to advance our understanding of the virus.

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This diagram summarizes the many ways humans in the US are protected from infection by avian H5N1 influenza. The USDA is active in other countries trying to help control the H5N1 outbreak in birds so there is activity even before the US border. At the border, the USDA has import restrictions on birds and bird products. No live birds or bird products are imported from countries with HPAI. USDA has increased surveillance in the live bird markets and, together with the Department of the Interior, has increased surveillance of the migratory wild bird population. Biosecurity procedures in poultry operations is of the greatest importance. These practices include control of human traffic, shower in and shower out facility, truck washing, cleaning and disinfection, careful introduction of new birds, and keeping wild birds and poultry separate. If AI would get through those prevention practices there is a robust AI response plan that has been practiced. The virus would be quickly identified and eliminated. Only the necessary workers would have contact with infected birds and they would be wearing PPE. The infected birds would be humanely euthanized. If for some reason an infected bird would be sent to slaughter, the Food Safety Inspection Service (FSIS) inspects the birds at slaughter. Any sign of disease would prevent those birds from entering the food supply. Other barriers for protecting humans from infection include avoiding contact with live poultry or poultry feces or respiratory secretion. In the unlikely event that poultry an avian influenza infected bird entered the food supply, proper handling and cooking would easily kill the virus. [Graphic by Clint May, CFSPPH, ISU, CVM]

Highly Pathogenic Avian Influenza

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Prevention: Humans

- Personal Protective Equipment
 - Gloves, masks
 - If working with poultry or wild birds
- Vaccine
 - April 17, 2007
 - US FDA approved an avian influenza vaccine for humans
 - Not commercially available
 - Part of National Strategic Stockpile
 - For distribution during public health emergency
- Antivirals

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On April 17, 2007, the U.S. Food and Drug Administration (FDA) announced its approval of the first vaccine to prevent human infection with one strain of the avian influenza (bird flu) H5N1 virus. The vaccine, produced by sanofi pasteur, Inc., has been purchased by the federal government for the U.S. Strategic National Stockpile; it will be distributed by public-health officials if needed. This vaccine will not be made commercially available to the general public. Other H5N1 vaccines are being developed by other companies against different H5N1 strains.

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Additional Resources

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For More Information

- Centers for Disease Control and Prevention (CDC)
 - <http://www.cdc.gov/flu/avian/>
- World Health Organization (WHO)
 - http://www.who.int/csr/disease/avian_influenza/en/
- World Organization for Animal Health (OIE)
 - www.oie.int
- Center for Food Security and Public Health
 - www.cfsph.iastate.edu

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