Avian Influenza in Avians (Poultry & Wild Birds)

Current Situation, Surveillance & Response

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1) Animal Health Regulatory Programs
   - Office of the State Veterinarian
   - Enforce state and federal animal health laws and regulations, and protect animal and public health through control of endemic, foreign and emerging diseases.
   - Animal Emergency Response – ESF-17; SCEMD

2) South Carolina Meat & Poultry Inspection Department

3) Veterinary Diagnostic Laboratory
Separating the Flus

- **Seasonal Human Influenza**
  - 10-20% population infected yearly
  - ~36,000 deaths yearly
  - H1 & H3 flu strains

- **Avian Influenza in “Avians”**
  - Mild strains see commonly in U.S. – Low Path AI
  - “Bad” strains see rarely – High Path AI

- **Pandemic Influenza**
  - New virus to humans, occurs globally
Biosecurity -- “Infectious Disease Control”

- Keep poultry indoors or penned
- Keep a “closed” flock (all in – all out production) or isolate new birds
- Control human, vehicular and equipment traffic onto farm
- Avoid other bird farms, auctions
- Pest / insect / wild bird control
Types of Poultry Raising
Commercial Poultry

- Commercial flocks
  - Companies with integrated systems (birds, feed mill, hatchery, processing)
  - Contact growers and company farms
  - Environmental controlled houses
    - Broilers – meat chickens we eat
    - Egg Layers – chickens lay eggs we eat
    - Turkeys – meat turkeys we eat
  - High level of biosecurity
Types of Poultry Raising

Commercial Poultry

Breeder Farms (chicken, turkey)

- Fertile eggs

Hatchery (artificial incubation)
Types of Poultry Raising
Commercial Poultry

Production farms -- Broiler
Hatchery → grow-out farm → processing plant

- Processed at 35 to 60+ days of age
- Average broiler farm
  - 25,000 birds per house
  - 2-4 houses
  - Grow 5 to 8 flocks of birds per year
Types of Poultry Raising
Commercial Poultry

Production farms -- Egg layers
Hatchery → pullet farm → lay farm → (eggs) processing plant

- **Average layer farm**
  - In production 1-2 years
  - 80,000-100,000 birds per house
  - 2 houses per farm on contract farms
  - 8+ houses per farm on company complexes
    (multi-age farms, 1 house is same age)
Types of Poultry Raising
Commercial Poultry

Production farms -- Turkeys
Hatchery → brooder farm → grow-out farm → processing plant

- Processed at 140 days of age
- Average turkey farm
  - 12,000 birds per house
  - 2-4 houses per farm
  - Grow 6 (baby flocks) to 2.5 (adult flocks) flocks per year
Types of Poultry Raising
Non-Commercial Poultry “Production Flocks”

- Non-commercial production flocks
  - Production flocks supplying Live Bird Markets
  - Free range flocks
  - Game bird (hunting) flocks

- Minimal to moderate biosecurity
Types of Poultry Raising
Non-Commercial Poultry “Backyard Flocks”

- Backyard flocks
  - Pets & Pleasure
  - Competition
    - Show birds, avian athletes
  - Family food / Urban poultry
    - Eggs, meat

- Minimal to no biosecurity practices
Avian Influenza (AI) Overview

- Type A Influenza virus - effects many avian species
- Disease was first reported in Italy, 1878 as “fowl plague”
- In U.S. first reported in 1924 – NY live bird markets
- Agent identified in 1955
- Worldwide distribution
Avian Influenza Overview

- Type A Viruses -- many different subtypes
  - Named by 2 surface proteins on the virus
    - “H” (hemagglutinin) = H1 – H16
    - “N” (neuraminidase) = N1 – N9
  - 144 different possible combinations = H5N1, H7N2, H1N1 . . . .

“Don’t judge a book by its cover.”
Pathogenicity of AI

- Based on specific molecular genetic and pathogenesis criteria that require specific testing

- **Low-pathogenic (LPAI)**
  - No clinical disease to mild/moderate disease in birds
  - Considered endemic in the U.S.

- **Highly pathogenic (HPAI)**
  - Severe illness and highly fatal disease in birds
  - Considered a Foreign Animal Disease (FAD) in U.S.

- **Mutations**
  - Low-Path form can change into High-Path form
  - Historically has been the H5 & H7 subtypes
Avian Influenza -- Different Situations

One category does not automatically lead into another

Low Path
High Path
Low/High Path
Zoonotic

Pandemic

In U.S.
Influenza Subtypes

Primordial Reservoirs for influenza viral genes

H1, H2, H3

H1, H3, H5, H7, H9

H1, H3

H1, H3, H4, H7, H13

H1-12, H14-15

Intermixing

H1-2, 4-7, H9-13, 15-16

H3, H7

H10

H1, H3, H4, H7, H13
Influenza Subtypes

- H1N1, H7N2, H7N3, H7N7, H9N2
- H1, H3
- H5N1, H7N7
- H3N8
- H7N7
Avian Influenza Transmission

- How the virus is spread:
  - Virus is shed from infected birds in feces and respiratory secretions.
  - Feces contain high levels of virus.
  - Contact with infected fecal material is the most common transmission between bird-to-bird and spread between poultry premises through fecal contamination of equipment, vehicles, personnel, outer surfaces of egg shells.
Avian Influenza in Wild Birds

- **Natural Reservoirs**
  - Waterfowl & shore birds
  - Migrate for long distances

- **LPAI types**
  - Can carry virus in GI without symptoms
  - Many subtypes including H5 & H7

- **HPAI types**
  - Rare to see in wild population before 2003
  - High mortality
Avian Influenza in Wild Birds

- The cycle
  - Wild LPAI reservoir ➔
  - Gene reasorting (25% 1+ subtype) ➔
  - Exposure & adaptation to domestic poultry (not natural host) ➔
  - Mutation into HPAI in domestic poultry ➔
  - Wild birds
Avian Influenza in Poultry

- Can see variable signs – ranging from none to severe, depending on the strain & pathogenicity

- **Low-Path AI**
  - No signs
  - Respiratory signs
  - Decreased egg production & poor shell quality
  - Virus *not* found in meat or eggs
Avian Influenza in Poultry

- High-Path AI
  - Severe respiratory & nervous signs
  - Facial edema, internal hemorrhages on leg shanks & internal organs
  - Mortality can be 100% in 48 hrs
  - Virus *could* be found in meat & eggs
Avian Influenza Survivability

- Virus can survive long periods in cool, moist environments:
- Protected in feces:
  - 35 days at 4 degrees C (~39 deg F)
  - 6 days at 37 degrees C. (~98 deg F)
- Easily killed with heat, drying, pH extremes, disinfectants
LPAI in U.S. Poultry

- Backyard flocks are the greatest risk to commercial flocks – because of their mobility & reduced Biosecurity practices.

- Both backyard and commercial flocks are equally at risk due to people negligence – not using Biosecurity.
Low-Path AI in U.S. Poultry

- Historically, turkeys were most commonly affected commercial poultry flocks due to range rearing & commingling with wild birds – this practice is declining.

- Commercial poultry infections have been linked back to the Live Bird Marketing System (1983-2004)
High-Path AI Outbreaks

- HPAI Disease Events since 1959
  - 1959 – Scotland – H5N1
  - 1961 – S. Africa – H5N3
  - 1963 – England – H7N3
  - 1966 – Canada – H5N9
  - 1976 – Canada – H7N7
  - 1979 – Germany – H7N7
  - 1979 – England – H7N7
  - 1983-84 – U.S. – H5N2
  - 1983 – Ireland – H5N8
  - 1985 – Canada – H7N1
  - 1991 – England – H5N1
  - 1992 – Australia – H7N3
  - 1994 – Australia – H7N3
  - 1994-95 – Mexico – H5N2
  - 1995 – Pakistan – H7N3
  - 1996-2014 – Eurasia/Africa – H5N1
  - 1997 – Australia – H7N4
  - 1997 – Italy – H5N2
  - 1999-2000 – Italy – H7N1
  - 2002 – Chile – H7N3
  - 2003 – Netherlands – H7N7
  - 2004 – Canada – H7N3
  - 2004 – U.S. – H5N2
  - 2004 – Pakistan – H7N3
  - 2004 – S. Africa – H5N2
  - 2005 – N. Korea – H7N7
  - 2006 – S. Africa – H5N2
  - 2007 – Canada – H7N3
  - 2008 -- UK – H7N7
  - 2009 – Spain – H7N7
  - 2011-13 – S. Africa – H5N2
  - 2012-13 – Mexico – H7N3
  - 2012 – Australia – H7N7
  - 2013 – Italy – H7N7
  - 2013 – Australia – H7N2
  - 2013 – China – H5N2
  - 2014 – Japan/Korea – H5N8
  - 2014 – Loas – H5N6
Avian Influenza - Public Health Impact

- **Pandemic** = a worldwide spread of a new human virus

- History – 3 Type A Flu human pandemics in 20\textsuperscript{th} century
  - 1918 (Spanish Flu) = 20-50 million died (700,000 U.S.)
    - “Mother of all pandemics”
  - 1957-58 (Asian Flu) = 1-2 million died
  - 1968-69 (Hong Kong Flu) = 1 million died

- Why so deadly?
  - People have no immunity to the new virus
  - Depends on virus strain if deadly or mild pandemic
Avian Influenza -- Public Health Impact

- 1959-1996, avian influenza infections in humans have occurred in 9 occasions
  - No serious illness nor deaths
  - Conjunctivitis / Influenza-like illness

- 1997 Hong Kong chickens: high-path H5N1
  - First time avian strain proven to infect humans directly – 18 human cases, 6 deaths
Avian Influenza – Asian H5N1 HPAI

- 1996 Asia high-path H5N1 (sick goose s. China)
- 1997 Hong Kong: high-path H5N1
  - Reassortment of ‘96 goose-like HA gene & 7 other genes from non-H5 AI viruses
  - First time of serious disease in humans – 18 human cases, 6 deaths
- 1998-2000 – H5N1 HPAI continues to circulate in geese in southern China, by 2000 multiple genotypes found in domestic ducks.
  - Geese to ducks – key event in genesis of subsequent panzootic, ducks play a major role in virus maintenance & spread into terrestrial poultry -- & perhaps into wild birds.
Avian Influenza – Asian H5N1 HPAI

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- 2004 – Lao, China, Cambodia, Malaysia (45 tigers in Thailand)
Avian Influenza – Asian H5N1 HPAI

- 2005 – emergence of new sublineage of H5N1 -- wild birds &/or poultry in southern Russia, Kazakhstan, Mongolia, Turkey, Romania, Ukraine, Croatia, Egypt, Africa
  - (Civet cats in Vietnam)

- 2006-2007 – through Africa, western Europe, west Asia, Middle East – wild birds, poultry, humans, other mammals (cats, stone marten, mink)

- 2010 – Bangladesh, Cambodia, Hong Kong, India, Israel, Myanmar, Nepal, Vietnam
High-Path AI Outbreaks in Birds

- 53 countries H5N1 HPAI poultry/wildlife 2003-14
- Map of all H5/H7 HPAI – 2005-2014
H5N1 HP Avian Influenza -- Human

- Cases: 650  Deaths: 386

Azerbaijan – 8 / 5
Bangladesh – 7 / 1
Cambodia – 47 / 33
Canada – 1 / 1
China – 45 / 30
Djibouti – 1 / 0
Egypt – 173 / 63
Indonesia – 195 / 163
Iraq – 3 / 2
Lao PDR – 2 / 2
Myanmar – 1 / 0
Nigeria – 1 / 1
Pakistan – 3 / 1
Thailand – 25 / 17
Turkey – 12 / 4
Viet Nam – 125 / 62
HP Avian Influenza -- Public Health Impact

- Human infections are due to close contact with dead or sick birds
  - Most in rural, semi-urban areas w/ small flocks
  - These farmers live closely with their animals, eat sick or dead animals
  - Poultry mix with other animals and wild birds
  - Total contrast to how U.S. commercial poultry are raised
Asian / Indonesian Live Bird Markets
Risk of HPAI Coming to U.S. How will it come?

- Legal & illegal movements of infected birds
  - Tremendous trade in exotic & wild birds
  - May be the biggest risk
- Legal & illegal movements of infected poultry products
- Migratory wild birds
- Intentional = Agro-Terrorism
Risk of HP H5N1 Coming to U.S. Migratory Wild Birds

- Wild bird migration patterns do not favor easy spread to North American flyways.....can it happen? Sure.

- Most routes run North & South.

- Overlap in Alaska & Canada.
Risk of HP H5N1 Coming to U.S. Migratory Wild Birds

- Uncommon to find same AI virus lineages in New World & Old World Hemispheres.
Risk of HP H5N1 Coming to U.S. Migratory Wild Birds


- Have found Low-Path AI
  – Don’t Panic!
Will High-Path H5N1 Come to U.S.?

- No one knows.
- We are use to fighting these fires -- firewalls in place:
- Poultry & poultry products from HPAI affected areas banned from entry into US
- Surveillance for AI in U.S. for 20+ years
- Management & biosecurity practices in US reduce the risk to commercial poultry
Avian Influenza – Public Concern

- Eating poultry meat & eggs

- In U.S. – no HPAI flock will go into the food chain = flock will be depopulated.

- Safe to eat properly cooked poultry meat and eggs.

- *Do I eat chicken? Yes.*
Avian Influenza – Public Concern

- **Hunters**
  - High-Path H5N1 not is U.S. yet
  - Hunt healthy birds
  - Use basic hygiene with game
    - Don’t eat, drink, smoke
    - Wear gloves, wash hands

- **Wild Bird Feeders**
  - High-Path H5N1 not in U.S. yet
  - Use basic hygiene
  - “Seed” birds don’t share same habitat as waterfowl
Routine National Avian Influenza Surveillance in Birds

- South Carolina participates in:
  - National Poultry Improvement Plan commercial poultry monitoring program
  - Live bird marketing systems (LBMS) surveillance
  - Wild bird surveillance (2006-10)
Routine SC Avian Influenza Surveillance in Poultry

National Poultry Improvement Plan (NPIP)

NPIP AI Clean Breeder Program –
- Commercial broiler, turkey & egg layer breeders.
  ~ 2,500 SC birds tested per year (~ 119 M nationally)
- Backyard/exhibition breeders & game bird breeders.
  ~ 1,900 SC birds tested per year (~ 20 M nationally)

NPIP H5/H7 LPAI Commercial Program --
- Commercial broilers, egg layers & turkeys prior to market.
  ~ 22,000 SC birds tested per year (~ 7 B nationally)

Necropsies (animal autopsies) & testing on commercial & backyard poultry submitted to Clemson Vet Diagnostic Lab
Routine SC Avian Influenza Surveillance in Poultry

Monitoring at poultry auctions, flea markets, fairs & shows – backyard flock inspections & testing

Part of National LBMS surveillance

- Random & “sick bird” sampling
- SC sampled:
  - ~1,500 birds per year
  - ~11,000 birds since 2002
- Nationally sampled: ~275,000 per year

Report large die-offs of poultry or wild birds

USDA Wildlife Services, SC Department Natural Resources & possibly USFW Service (DOI)

2006 -- Focus on geese, ducks & shorebirds that migrate between Alaska and Asia

2007 – Focus on certain waterfowl
   Sampling live birds
   Investigate wild bird die offs
   Sample hunter-killed birds – ducks
Routine USDA Imported Bird Surveillance

USDA mandates quarantine and testing on all international imported birds for avian influenza.

1 quarantine facility for live birds in NY

- Poultry
- Pet birds
- Zoo birds
- Ratites (ostrich, emus)

Ban on live birds from areas with HPAI
Influenza Surveillance in Birds

State bird surveillance testing will not differentiate between LPAI & HPAI strains.

Clemson Veterinary Diagnostic Lab
- PCR = detect Avian Influenza, H5 or H7 subtypes (4-6 hrs)
- State lab results = presumptive positive

Confirmation results from USDA National Veterinary Services Laboratory (NVSL), Ames, IA.
Economics of Notifiable Avian Influenza

- **Notifiable Avian Influenza** –
  - An infection of poultry caused by any H5 or H7 subtype influenza A virus, or
  - Any AI virus determined to be Highly-Pathogenic
  - Reported to OIE

--- World Organization for Animal Health

- Intergovernmental organization responsible for improving animal health worldwide – U.S. is a member.
- It is recognized as a reference organization by the World Trade Organization (WTO)
- International standards for NAI poultry cases allow countries to impose export bans up to 3 months.
Economics of Notifiable Avian Influenza

- **International Export Bans**
  - On live birds, hatching eggs, meat/egg products; up to 3 months after farm has been cleaned and disinfected.
  - **HPAI bans** -- start with the entire U.S. and then reduced to county/Counties around the infected premises.
  - **H5/H7 LPAI bans** -- start with entire state and **may** be reduced to county level around the infected premises.
  - **State transit bans** -- countries won’t except product that has been transported through the infected premises’ state.
  - 2006 – SC #10 in exported poultry & poultry products = $83 M
Economics of Notifiable Avian Influenza

- **Infected Farm** – Costs to growers, companies & USDA
  - Depopulation and disposal of flock, cleaning & disinfection of farm (approved USDA indemnity will assist in costs).
  - Costs of lost production, extended downtime before receiving next flock.

- **Surrounding Farms** – Costs to companies, State & USDA
  - Increased surveillance testing (USDA reimburse)
  - Increased personnel hours/travel (USDA reimburse state employees, but not company employees)
Avian Influenza Vaccination

- What about vaccinating poultry?
- Would only be used during an outbreak as a control measure.
- Vaccinated birds interfere with surveillance testing and trade issues.
Emergency Animal Disease Response Plan

- Farm quarantine
  - Animals and equipment
  - Zone quarantines?

- Mandatory Biosecurity measures implemented for people and vehicles to exit farm or zones.
Emergency Animal Disease Response Plan

- Zones – surveillance & restricted movement
Emergency Animal Disease Response Plan

- Depopulation of flock or herd

- Disposal of carcasses – need several options
  - On-site
    - Preferred to removing off the farm – lower risk of spreading disease to other farms
    - Compost
    - Burial
  - Off-site
    - Landfill
    - Rendering
    - Incineration
Emergency Animal Disease Response Plan

- Farm buildings & equipment disinfected
- Litter heated / composted to kill virus
- Downtime
- Repopulation
- Business Continuity
Awareness

- **SC Ag-Watch Program** (www.SCAgWatch.com)
  - Producer & Responder Programs
  - Using Biosecurity to protect our Industries
  - Awareness of Diseases & Biosecurity Measures
  - SC contact numbers
Training

- Biosecurity – State & Federal Ag Personnel
- PPE & Surveillance Training – “Strike Teams”
Home Team Advantage

- We are ready to respond.
- Plans for worse case scenario & hope for the best.
  - Early detection
  - Rapid Diagnosis
  - Training in Personal Protective Equipment (PPE)
  - Working with industry on current response plans
  - Experience with aggressive action on quarantine / depopulation / clean up