

# Newcastle Disease

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**Newcastle Disease**

Exotic Newcastle Disease, Pseudo-Fowl Pest,  
Pseudovogel-Pest, Atypical Geflugelpest,  
Pseudo-Poultry Plague, Avian Pest, Avian  
Distemper, Ranikhet Disease, Tetelo Disease,  
Korean Fowl Plague, and Avian  
Pneumoencephalitis

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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, 2011

In today's presentation we will cover information regarding the organism that causes Newcastle disease 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 (including humans), clinical and necropsy signs seen, and diagnosis and treatment of the disease. Finally, we will address prevention and control measures for the disease, as well as actions to take if Newcastle disease is suspected.

(Photo: USDA-APHIS)

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**The Organism**

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**Newcastle Disease**

- Family Paramyxoviridae
  - Genus *Avulavirus*
- 9 serotypes
  - APMV-1 to APMV-9
- Newcastle disease is APMV-1
  - Lentogenic, mesogenic, velogenic
  - Neurotropic, viscerotropic

Center for Food Security and Public Health, Iowa State University, 2011

Newcastle disease viruses are in the genus *Avulavirus* of the family Paramyxoviridae. There are nine avian paramyxovirus serotypes designated APMV-1 to APMV-9. Of these, Newcastle disease virus, which is APMV-1, remains the most important pathogen for poultry, but APMV-2, APMV-3, APMV-6, and APMV-7 also cause disease in poultry. APMV-1 strains are classified into three pathotypes based on their virulence in chickens. Lentogenic strains are the least virulent, mesogenic strains are moderately virulent, and velogenic strains are the most virulent. Most strains cluster toward the two extremes of virulence, and are either lentogenic or velogenic. Velogenic viruses can be subdivided into a neurotropic form, which is typically associated with respiratory and neurologic signs, and a viscerotropic form with hemorrhagic intestinal lesions.

## Newcastle Disease

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### Newcastle Disease

- vND: virulent Newcastle Disease
  - Mesogenic
  - Velogenic neurotropic
  - Velogenic viscerotropic
- “Exotic Newcastle Disease” (END)
  - U.S. definition for velogenic viscerotropic strains of Newcastle



Center for Food Security and Public Health, Iowa State University, 2007

The nomenclature used to describe ND is confusing, as sometimes infection of birds with any strain of the NDV may be termed ND. Less virulent strains may induce severe disease when exacerbated by the presence of other organisms or by adverse environmental condition. To avoid confusion, the abbreviation vND will be used in this presentation for the disease caused by the virulent strains of virus which includes mesogenic, velogenic neurotropic, and velogenic viscerotropic strains.

(Photo: USDA-APHIS)

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### Importance

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### History

- 1926
  - Java, Indonesia
  - Newcastle-upon-Tyne, England
- Probable earlier outbreaks in Central Europe
- 1896: Western Scotland, cause of death of all chickens?
- 4 panzootics from 1926 to 1981

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The first outbreaks of vND occurred in 1926 in Java, Indonesia and in Newcastle-upon-Tyne, England. There are reports of disease outbreaks in Central Europe similar to what we now recognize as vND that predate 1926. The disease may have been the cause of death of all the chickens in the Western Isles of Scotland in 1896. Four panzootics of vND are believed to have occurred: from 1926 to the 1960s; from the 1960s to 1973; during the late 1970s; and from the late 1970s to 1981.

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### History in U.S.

- 1950: First U.S. case
  - Partridges and pheasants imported from Hong Kong
- 1971 to 1974: California
  - 1,321 infected and exposed flocks
  - 12 million birds destroyed
  - \$56 million cost to tax payers
- Additional U.S. outbreaks
  - Illegal importation of exotic birds, poultry

Center for Food Security and Public Health, Iowa State University, 2011

The first case of vND occurred in 1950 in partridges and pheasants imported from Hong Kong. In November 1971, a major outbreak occurred in commercial flocks in southern California after the arrival of a shipment of infected pet birds from Latin America. In March of 1972, a national animal health emergency was declared and a major eradication campaign began. During the 2 year effort, 1,321 infected and exposed flocks were located, and almost 12 million birds were destroyed. The operation cost taxpayers approximately \$56 million. In July 1974 the U.S. succeeded in eradicating vND. Frequent outbreaks of vND have occurred in the U.S. since due to illegal importation of exotic birds and poultry.

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### History in U.S.

- 2002 to 2003: California
  - 2,662 premises depopulated
  - 4 million birds destroyed
  - \$160 million cost



Center for Food Security and Public Health, Iowa State University, 2011

In October 2002, vND was confirmed in the State of California. Cases also occurred in Nevada, Arizona, Texas, and New Mexico. As of July 7, 2003, with the epidemic in the final phase of eradication, almost 4 million birds on 2,662 premises had been depopulated, and eradication efforts have cost taxpayers \$160 million.

(Photos: USDA-APHIS from the 2002/2003 California outbreak)

## Newcastle Disease

S 1 i d e 1 0	<p style="text-align: center;"><b>Economic Impact</b></p> <ul style="list-style-type: none"><li>• Global economic impact<ul style="list-style-type: none"><li>– vND more costly than any other animal virus?<ul style="list-style-type: none"><li>• Control measures expensive</li><li>• Repeated testing for trade purposes</li></ul></li></ul></li><li>• Developing countries<ul style="list-style-type: none"><li>– Endemic vND affects quality and quantity of dietary protein</li><li>– Significant effect on human health</li></ul></li></ul> <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2011</p>	<p>The global economic impact of vND is enormous. No other poultry virus comes close in terms of the economic impact, and it may represent a bigger drain on the world's economy than any other animal virus. In developed countries, outbreaks of vND are extremely costly and control measures, including vaccination, are a continuing loss to the poultry industry. Countries free of vND are faced with repeated testing to maintain that status for trade purposes.</p> <p>In developing countries with endemic vND, the economic impact is an important limiting factor in development of commercial poultry and the establishment of trade links. Many developing countries rely on village chickens to supply a significant portion of dietary protein in the form of eggs and meat, especially for women and children. Continued losses from vND affect the quantity and quality of the food for people on marginal diets. The economic impact of vND is not only measured in direct commercial losses, but in some countries, also in the effect it has on human health.</p>
S 1 i d e 1 1	<p style="text-align: center;"><b>Epidemiology</b></p>	
S 1 i d e 1 2	<p style="text-align: center;"><b>Geographic Distribution</b></p> <ul style="list-style-type: none"><li>• Endemic<ul style="list-style-type: none"><li>– Asia, the Middle East, Africa, Central and South America</li></ul></li><li>• Vaccine use makes assessment of true geographical distribution difficult</li><li>• International monitoring<ul style="list-style-type: none"><li>– FAO</li><li>– OIE</li></ul></li></ul> <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2011</p>	<p>vND is endemic in many parts of the world including countries in Asia, the Middle East, Africa, and Central and South America. Some countries in Europe are free of the disease. The United States and Canada have seen high mortality in wild cormorants caused by vND. The almost worldwide use of ND vaccines in commercial poultry makes assessment of the true geographic distribution of ND virus difficult. Although international monitoring of ND is carried out by the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE), figures may not represent the true distribution of vND.</p>
S 1 i d e 1 3	<p style="text-align: center;"><b>Morbidity/Mortality</b></p> <ul style="list-style-type: none"><li>• Morbidity: up to 100%</li><li>• Mortality: 90%</li><li>• Varies greatly depending on<ul style="list-style-type: none"><li>– Virulence and strain</li><li>– Avian species and susceptibility of host</li><li>– Environmental conditions</li><li>– Vaccination history</li></ul></li><li>• Some species show few or no signs<ul style="list-style-type: none"><li>– Carrier state may exist</li></ul></li></ul> <p style="text-align: right; font-size: small;">Center for Food Security and Public Health, Iowa State University, 2011</p>	<p>Morbidity and mortality rates can vary greatly depending on the virulence of the virus strain and susceptibility of the host. Environmental conditions, secondary infections, vaccination history, and avian species all affect these rates. The disease affects both domestic and wild bird populations. In chickens, morbidity can be up to 100% with 90% mortality. In other species, such as finches and canaries, clinical signs may not be present. A carrier state may exist in psittacine and some other wild birds. Ducks and geese may be infected and show few or no clinical signs, even with strains lethal for chickens.</p>

# Newcastle Disease


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## Transmission

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### Animal Transmission

- Direct contact with feces, respiratory secretions
- Indirect contact
  - Feed, water
  - Equipment
  - Human clothing
- Contaminated or incompletely inactivated vaccines



Center for Food Security and Public Health, Iowa State University, 2011

Transmission can occur by direct contact with feces and respiratory discharges or by contamination of the environment, including food, water, equipment, and human clothing. Virus is present in all parts of the carcass of an infected bird. The greatest potential for spread of the disease is by humans and their equipment. The following have been implicated in various epizootics: movement of live birds, contact with other animals, movement of people and equipment, movement of poultry products, airborne, contaminated poultry feed, contaminated water, and contaminated or incompletely inactivated vaccines.

(Photo: USDA-APHIS, 2002/2003 California outbreak)

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### Animal Transmission

- Survives for long periods in the environment
- Incubation period
  - 2 to 15 days
  - 5 to 6 days average
- Migratory birds, feral pigeons
  - Contamination of poultry feed

Center for Food Security and Public Health, Iowa State University, 2011

Newcastle disease virus can survive for long periods in the environment, especially in feces. Generally, virus is shed during the incubation period and for a short time during recovery. Some psittacine species can shed the virus intermittently for a year or more. The incubation period varies from 2 to 15 days (average 5 to 6) depending on the severity of the strain and susceptibility of the population. Migratory birds have been implicated in the primary introduction of the virus, with outbreaks being the result of secondary spread by humans. Feral pigeons have also been implicated in the contamination of poultry feed.

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### Human Transmission

- Mild conjunctivitis
  - Virus shed in ocular secretions
  - Avoid contact with avian species
- Lab workers and vaccination crews most at risk
- No cases from handling or consuming poultry products
- No human-to-human spread

Center for Food Security and Public Health, Iowa State University, 2011

People can become infected with vND and show signs of conjunctivitis. The conjunctivitis usually resolves quickly, but virus can be shed in ocular discharges for 4 to 7 days. Infected individuals should avoid direct and indirect contact with avian species during this time. Laboratory workers and vaccination crews are most at risk, with poultry workers rarely being infected. No known infections have occurred from handling or consuming poultry products.


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**Animals and Virulent Newcastle Disease**

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**Clinical Signs**

- Drop in egg production
- Numerous deaths within 24 to 48 hours
- Deaths continue for 7 to 10 days
- Surviving birds may have neurological or reproductive damage



Center for Food Security and Public Health, Iowa State University, 2011

Clinical signs that can be seen, particularly in chicken flocks, include an initial drop in egg production followed by numerous deaths within 24 to 48 hours. Deaths in the flock may continue for 7 to 10 days. Birds that survive for 12 to 14 days usually live but may have permanent neurological damage including paralysis, and reproductive damage causing decreased egg production.

(Photo: USDA-APHIS from 2002-2003 California outbreak)

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**Clinical Signs**

- Edema of head, especially around eyes
- Greenish, dark watery diarrhea
- Respiratory and neurological signs
- Signs vary with species and virulence



Center for Food Security and Public Health, Iowa State University, 2011


Clinical signs may include edema of the head, especially around the eyes, and greenish-dark watery diarrhea, as well as respiratory and neurological signs. Neurologic signs may include muscle tremors, drooping wings, dragging legs, twisting of the head and neck, circling, depression, inappetence, or complete paralysis. Clinical signs associated with the various strains can be different in species other than chickens. Vaccinated birds will have less severe signs.

(Photo: USDA-APHIS from 2002-2003 California outbreak)

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**Post Mortem Lesions**

- Edema of head, neck
- Edema, hemorrhage, necrosis or ulceration of lymphoid tissue
- Hemorrhagic lesions
  - Tracheal mucosa
  - Proventriculus
  - Intestinal mucosa



Center for Food Security and Public Health, Iowa State University, 2011

There are no specific diagnostic post mortem lesions seen with vND. Gross lesions can be very similar to highly pathogenic avian influenza, so laboratory isolation and identification is important for a definitive diagnoses. Lesions may include: edema of the interstitial tissue of the neck, especially near the thoracic inlet; congestion and sometimes hemorrhage on the tracheal mucosa; petechiae and small ecchymoses on the mucosa of the proventriculus; edema, hemorrhages, necrosis, or ulcerations of lymphoid tissue in the intestinal wall mucosa, including Peyer's patches; and edema, hemorrhages, or degeneration of the ovaries. Edema or necrosis of the cecal tonsil and lymphoid tissue of the intestinal wall is especially suggestive of ND.

(Photo: USDA-APHIS from 2002-03 California outbreak)

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**Differential Diagnosis**

- Highly pathogenic avian influenza
- Fowl cholera
- Laryngotracheitis
- Coryza
- Fowl pox (diphtheritic form)
- Psittacosis or Pacheco's disease
- Mycoplasmosis
- Infectious bronchitis
- Management problems
  - Water or feed deprivation
  - Poor ventilation


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Differential diagnoses include highly pathogenic avian influenza, fowl cholera, laryngotracheitis, coryza, fowl pox (diphtheritic form), psittacosis or Pacheco's disease in psittacines, mycoplasmosis, infectious bronchitis, as well as management problems, such as water or feed deprivation or poor ventilation.

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**Clinical Diagnosis**

- Sudden decrease in egg production
- High morbidity and mortality
- Characteristic signs and gross lesions



Center for Food Security and Public Health, Iowa State University, 2011

Virulent Newcastle disease may be suspected, especially in chicken flocks, with a sudden decrease in egg production, high morbidity and mortality, and characteristic signs and gross lesions; however, due to the wide variety of signs and similarities to other avian diseases, such as highly pathogenic avian influenza, definitive diagnosis requires virus isolation and identification in the laboratory.

(Photo: USDA-APHIS)

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**Sampling**

- 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

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Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities (state and/or federal veterinarian) should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.

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**Laboratory Diagnosis**

- Virus isolation
- RT-PCR
- Serology
  - No strain information
  - Cannot differentiate infected from vaccinated animals
  - May be used post-vaccination to confirm immune response

Center for Food Security and Public Health, Iowa State University, 2011

Due to the presence of some strains in feral birds and the use of viruses as live vaccines, isolation of Newcastle Disease Virus is rarely sufficient to confirm a diagnosis of disease. Virus characterization by pathogenicity testing or nucleotide sequencing is necessary to determine strain and pathogenicity – necessary information for control measures. Tests available for serology include hemagglutination-inhibition and ELISA. Serology gives little information on strain and is thus of limited diagnostic value. Serology cannot be used to differentiate infected from vaccinated birds, but may be used to confirm immune response in vaccination programs.

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**Newcastle Disease in Humans**

## Newcastle Disease

S 1 i d e 2 7	<h3>Clinical Signs in Humans</h3> <ul style="list-style-type: none"><li>• Eye infections<ul style="list-style-type: none"><li>– Reddening, excessive tearing, edema of lids, conjunctivitis, subconjunctival hemorrhage</li><li>– Usually transient, cornea not affected</li><li>– Lab workers and vaccination crews most susceptible</li><li>– No human-to-human spread</li></ul></li></ul> <small>Center for Food Security and Public Health, Iowa State University, 2011</small>	<p>Eye infections, consisting of unilateral or bilateral reddening, excessive tearing, edema of the eyelids, conjunctivitis, and subconjunctival hemorrhage have occurred. Infections are usually transient and the cornea is not affected. Both vaccine and virulent poultry strains of NDV may infect and cause clinical signs in humans. Human infections have resulted from direct contact with the virus in laboratory settings, contamination with virus after handling infected birds or carcasses, and contamination of vaccination personnel, especially when vaccines are given by aerosol. These infections can usually be avoided through the use of protective eyewear, protective clothing, and good personal hygiene. Casual contact with infected poultry is a low risk situation for humans. There are no reports of human-to-human spread.</p>
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S 1 i d e 2 8	<h3>Prevention and Control</h3>
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S 1 i d e 2 9	<h3>Recommended Actions</h3> <ul style="list-style-type: none"><li>• IMMEDIATELY notify authorities</li><li>• Federal<ul style="list-style-type: none"><li>– Area Veterinarian in Charge (AVIC) <a href="http://www.aphis.usda.gov/animal_health/area_offices/">http://www.aphis.usda.gov/animal_health/area_offices/</a></li></ul></li><li>• State<ul style="list-style-type: none"><li>– State veterinarian <a href="http://www.usaha.org/StateAnimalHealthOfficials.pdf">http://www.usaha.org/StateAnimalHealthOfficials.pdf</a></li></ul></li><li>• Quarantine</li></ul> <small>Center for Food Security and Public Health, Iowa State University, 2011</small>	<p>If you suspect a case of vND, state or federal authorities should be notified immediately. Animals suspected with vND should be isolated, and the farm should be quarantined until definitive diagnosis is determined.</p>
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S 1 i d e 3 0	<h3>Recommended Actions</h3> <ul style="list-style-type: none"><li>• Confirmatory diagnosis</li><li>• Depopulation may be necessary</li><li>• Destruction<ul style="list-style-type: none"><li>– Exposed carcasses</li><li>– Litter</li><li>– Animal products</li></ul></li></ul>  <small>Center for Food Security and Public Health, Iowa State University, 2011</small>	<p>Should virulent Newcastle Disease be confirmed by diagnosis, depopulation may be necessary. Proper destruction of all exposed carcasses, litter, and animal products are required.</p> <p>(Photo-USDA-APHIS from the 2002-2003 END outbreak California. It shows cleaning and disinfection crews on a backyard poultry site.)</p>
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## Newcastle Disease

S 1 i d e 3 1	<h3>Control and Eradication</h3> <ul style="list-style-type: none"><li>• Disinfection of premises</li><li>• Delay re-introduction of new birds for 30 days</li><li>• Control insects and mice</li><li>• Limit human traffic</li></ul>  <p><small>Center for Food Security and Public Health, Iowa State University, 2011</small></p>	<p>Additional recommendations for the control and eradication of Newcastle disease will include disinfection of the premises, delaying reintroduction of new birds for 30 days, control of pests such as insects and mice, limiting human traffic, and avoiding the introduction of new animals with unknown health status.</p> <p>(Photo: USDA-APHIS, euthanization of birds by compressed gas – CO<sub>2</sub>)</p>
S 1 i d e 3 2	<h3>Disinfection</h3> <ul style="list-style-type: none"><li>• Household bleach, 6%</li><li>• Extremes in pH<ul style="list-style-type: none"><li>– Less than 2 or greater than 12</li></ul></li><li>• Heat<ul style="list-style-type: none"><li>– Boiling one minute</li></ul></li><li>• Detergents</li><li>• Dryness</li><li>• Ultraviolet light and sunlight</li></ul> <p><small>Center for Food Security and Public Health, Iowa State University, 2011</small></p>	<p>Effective disinfectants include the cresylics and phenolics, including Novalsan-S, Roccal-D Plus, and 6% household bleach. The virus can be killed by pH extremes of below 2 and above 12, heat (boiling for one minute), detergents, dryness, ultraviolet light, and sunlight. The virus can survive for long periods of time in cool moist environments, in warm, humid environments, at pH between 2 and 12 and at least 3 months in liquid manure. The virus can also survive freezing.</p>
S 1 i d e 3 3	<h3>Vaccination</h3> <ul style="list-style-type: none"><li>• Vaccination routine worldwide</li><li>• Reduces clinical signs</li><li>• Does not prevent virus replication or shedding</li><li>• Not an alternative to good management, biosecurity, or good hygiene</li></ul> <p><small>Center for Food Security and Public Health, Iowa State University, 2011</small></p>	<p>Vaccination is routine in poultry flocks. While vaccination will reduce the severity of clinical disease caused by vND it will not prevent infection and virus shedding. Under no circumstances can vaccination be regarded as an alternative to good management practice, biosecurity, or good hygiene when rearing domestic poultry.</p>
S 1 i d e 3 4	<h3>Additional Resources</h3>	
S 1 i d e 3 5	<h3>Additional Resources</h3> <ul style="list-style-type: none"><li>• World Organization for Animal Health (OIE)<ul style="list-style-type: none"><li>– <a href="http://www.oie.int">www.oie.int</a></li></ul></li><li>• U.S. Department of Agriculture (USDA)<ul style="list-style-type: none"><li>– <a href="http://www.aphis.usda.gov">www.aphis.usda.gov</a></li></ul></li><li>• Center for Food Security and Public Health<ul style="list-style-type: none"><li>– <a href="http://www.cfsph.iastate.edu">www.cfsph.iastate.edu</a></li></ul></li><li>• USAHA Foreign Animal Diseases ("The Gray Book")<ul style="list-style-type: none"><li>– <a href="http://www.usaha.org/pubs/fad.pdf">www.usaha.org/pubs/fad.pdf</a></li></ul></li></ul> <p><small>Center for Food Security and Public Health, Iowa State University, 2011</small></p>	



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**Authors:** Katie Steneroden, DVM; Anna Rovid Spickler, DVM, PhD; Radford Davis, DVM,  
MPH, DACVP  
**Reviewers:** Bindy Comito Sornsin, BA; Katie Spaulding, BS; Kerry Leedom Larson, DVM,  
MPH, PhD

Center for Food Security and Public Health, Iowa State University, 2011