Newcastle disease is a highly contagious viral disease that causes respiratory and neurological signs in various avian species. It may cause acute death.

Newcastle disease is caused by avian paramyxovirus-1 (APMV-1). APMV-1 generally presents in the following forms based on clinical signs: lentogenic (mild), mesogenic (moderate), and velogenic (severe). Other names for Newcastle disease include: Avian Paramyxovirus-1 (APMV-1), exotic Newcastle disease (END), virulent Newcastle disease (VND), pseudo-fowl pest, pseudo-poultry plague, and Ranikhet disease. Newcastle disease is an important poultry disease because it is endemic in many areas worldwide, including Asia, Africa, and parts of North and South America. Chickens are the most susceptible species and can experience 100% mortality with velogenic strains within 24 – 48 hours. Newcastle disease causes a significant economic impact, especially in developing countries that rely heavily on backyard chickens for income and as a protein source.

Clinical signs

Observed signs can vary greatly depending on the APMV-1 strain and bird host factors (species, age, immunity, etc.).

Respiratory signs may include:

- sneezing
- conjunctivitis (swelling around the eyes or face)

Neurological signs may include:

- paralyzed wings or legs
- torticollis (twisted neck; Figure 1)
- muscle tremors or spasms

Weakness, oral discharge (Figure 2) greenish colored diarrhea (Figure 3), decreased egg production, and eggs that are thin-shelled, pale, and/or have a watery albumin may be observed. With velogenic strains, especially in susceptible chickens, mortality death may be close to 100% in a flock.

Figure 1. Torticollis in a broiler chicken affected with Newcastle disease. Photo credit: Dr. Lorenzoni.
Figure 2. Abundant oral secretion in a bird affected with Newcastle disease. Photo: Dr. R. Gallardo.

Figure 3. Greenish fecal material from chickens affected with Newcastle disease. Photo credit: Dr. R. Gallardo.

Figure 4. Hemorrhagic proventricular papillae in a chicken affected with Newcastle disease. Photo credit: Dr. R. Gallardo.

Figure 5. Hemorrhagic trachea of a chicken affected with Newcastle disease. Photo credit: Dr. R. Gallardo.

Necropsy findings

Gross lesions may vary but may include hemorrhage of the mucosa of the proventriculus (Figure 4), ceca, and small intestine, due to necrosis of the intestinal wall or lymphoid tissue. In the respiratory tract, hemorrhage and marked congestion may be seen in the trachea (Figure 5). Airsacculitis may also be seen, shown by thickening of the air sacs and mucus (catarrhal) or cheese-like (caseous) build-up, and is often associated with secondary bacterial infections. Laying birds may have egg yolk in the abdominal cavity, degenerative ovarian follicles, and/or hemorrhage of the reproductive tract.
Occurrence

APMV-1 has been reported in over 240 bird species, and velogenic APMV-1 is endemic in many developing countries. Chickens are the most susceptible to the velogenic strain and the most likely to succumb to disease mortality or have severe clinical signs. Turkeys are usually less susceptible, with lower mortality and less severe morbidity in clinical presentation. Other game bird species such as pheasants, partridges, quail, and guinea fowl have variable susceptibility, but severe clinical signs have been reported with exposure to velogenic strains. Waterfowl species such as ducks and geese are generally the least susceptible and may harbor subclinical infections. Psittacine bird species, including parrots, cockatiels, budgerigars, and conures can be infected, and there have been cases in which they have had subclinical carriers of the virus and have introduced it into areas that were previously not affected. A variety of exotic zoo birds such as ostriches, owls, raptors, and penguins have been affected to varying degrees as well. Outbreaks in wild double-crested cormorants and rock pigeons have been reported throughout the U.S. and Canada, with limited spillover into domestic poultry. There have been sporadic Newcastle disease introductions to U.S. domestic poultry, mainly through the introduction of imported poultry that were infected, as well as wild bird reservoirs.

There have been three extensive U.S. outbreaks of the virulent Newcastle disease, previously known as exotic Newcastle disease (END), based mainly in southern California. The first outbreak occurred from 1971 to 1974 and was linked to the importation of infected psittacine pet birds into the U.S. During the 2002-2003 outbreak, the disease began in illegally imported backyard gamefowl and spread to commercial egg layer farms. The most recent outbreak lasted two years, May 2018 to May 2020, affected backyard gamefowl and spilled into commercial layer facilities; in this outbreak, the disease was called virulent Newcastle disease (VND) because it was no longer considered exotic to the U.S. Wild bird introduction of the virus can also occur from cormorants, pigeons, doves, and migratory waterfowl, which can be subclinical carriers of the disease.

People who are exposed to large amounts of virus may experience a mild and typically self-limiting conjunctivitis (eye swelling, irritation and redness) and flu-like symptoms of fever, headache, and malaise. Laboratory workers, vaccine crews, and emergency disease poultry responders are most at risk. Conjunctivitis usually resolves without treatment but can be shed in ocular discharge for 4 to 7 days. Due to the relatively minor disease manifestation of Newcastle in humans, it is not a significant zoonotic disease of public health concern and is not considered a foodborne transmitted disease.

Transmission

APMV-1 is acquired through ingestion or inhalation of manure or respiratory secretions from infected birds. The virus can also be transferred via fomite materials such as contaminated feed, water, shoes, clothing, vehicles, poultry crates and egg trays, and, especially, moist fecal material. Transmission can also occur through infected eggs to hatching chicks for some APMV strains. Incubation period is 2-15 days, with an average of 2-6 days in chickens exposed to velogenic strains. Gallinaceous birds typically shed virus for 1-2 weeks. However, psittacine species such as parrots, macaws, and parakeets can be prolonged shedders of APMV-1 for months to more than a year.

Diagnosis

Confirmation of APMV-1 via laboratory diagnosis is important because the virus can mimic many other poultry diseases such as avian influenza. Diagnostic tests may include:

- **Real-Time Reverse-Transcriptase Polymerase Chain Reaction (qRT-PCR)** – detects the presence of viral RNA from swab samples from oropharyngeal or cloacal swab samples
- **Virus isolation (VI)** – determines if viable virus is present by incubating embryonated eggs and determines virus type from swab samples
- **Serology Blood Tests** (i.e. Enzyme Linked Immunosorbent Assay (ELISA), Agar Gel Immunodiffusion (AGID), Hemagglutination Assay (HA) / Hemagglutination Inhibition Assay (HI)) - identifies antibodies in blood serum; used as a screening test

Differential diagnoses

Avian influenza, Avian Paramyxovirus, Infectious bronchitis, Infectious laryngotracheitis, Avian chlamydia, Mycoplasma, Avian cholera (pasteurellosis), Infectious coryza, acute poisoning (i.e. aflatoxin, insecticides, rodenticides), Egg drop syndrome (EDS 76), Duck plague (duck viral enteritis)
**Prevention**

Biosecurity remains the most important protection strategy. Practices such as avoiding visiting other places with birds and restricting visitors around your birds are helpful strategies to limit disease spread. Prior to anyone entering your poultry premises, it is recommended to have them park in a designated area away from your birds, use a properly maintained footbath or wear designated cleaned footwear and/or clothing, and disinfect hands. Clean and disinfect poultry equipment such as cages, crates, egg flat/racks, waterers, and feeders prior to reuse. APMV-1 is an enveloped RNA virus and is susceptible to most common disinfectants. The virus is inactivated by heating to 56 °C (133 °F) for 3 hours or 60 °C (140 °F) for 30 minutes. Acidic conditions with a pH ≤ 2 also kill the virus. Similar to other viruses, APMV-1 can survive for long periods in cool conditions and in organic material such as feces.

Know the signs of illness to report quickly to your local state Department of Agriculture for follow-up to prevent future disease spread. The velogenic form of Newcastle disease is reportable to the World Organization for Animal Health (OIE), which provides international guidelines for surveillance and eradication. Biosecurity information is also posted on the USDA and CDFA websites to provide education to poultry and pet bird owners to prevent disease.

Vaccination with live or inactivated lentogenic strains (i.e. B1 and/or LaSota) for chickens, turkeys and pigeons are available by mass application in drinking water or aerosol droplet spray. Individual birds can also receive eye or nose droplet vaccination. Layer and breeder birds are often vaccinated prior to the first lay to pass on maternal antibodies to their chicks. Chicks may also be vaccinated at 1-4 days of age at the hatchery, especially if the parent stock was not vaccinated, or at 2-3 weeks of age once maternal antibodies wane. There is often a withdrawal period especially for oil-based vaccines for birds intended for human consumption.

Vaccination with these lentogenic strains provides only a limited protection against more virulent (mesogenic or velogenic) APMV-1 strains. Vaccinated birds exposed to more serious strains may still experience a decline in egg production and neurological signs, with less mortality. Vaccinated poultry can continue to shed virus in feces and saliva, despite vaccination status, but may experience reduced respiratory illness and mortality.

**References and suggested reading**


OIE. 2019.

Iowa State University, Center for Food Security & Public Health (2016). *Newcastle Disease – Technical Factsheet*. (PDF)


California Department of Food and Agriculture (2019). *Virulent Newcastle Disease*.

USDA APHIS VS (2018). *Virulent Newcastle Disease Virus (vNDV) Case Definition*. (PDF)
