Coronaviridae

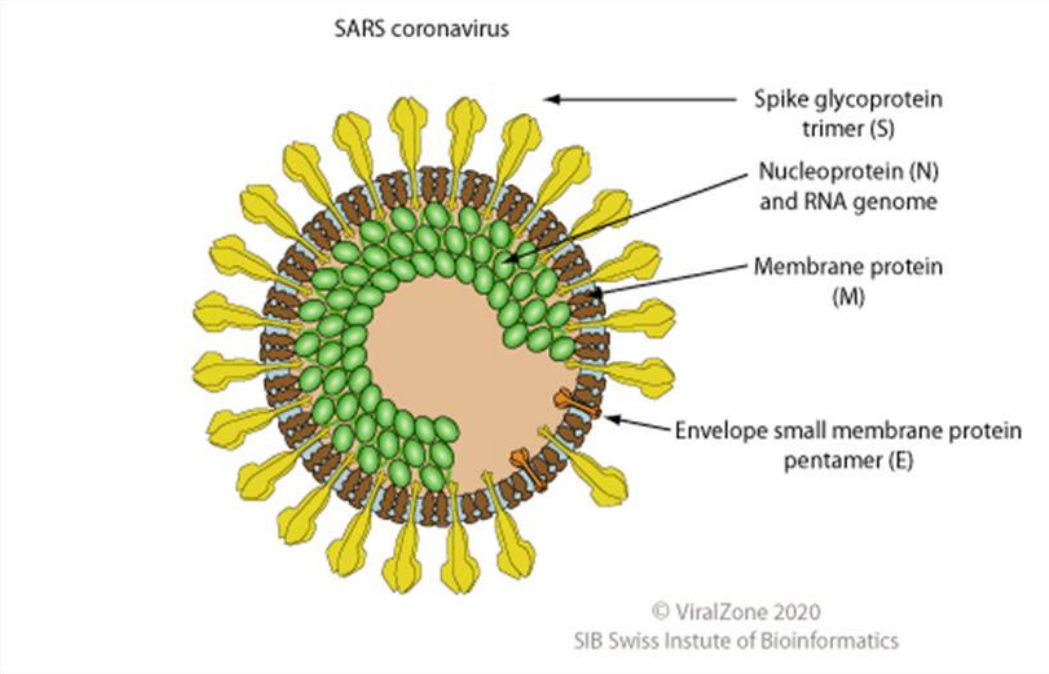
Infectious Bronchitis
Transmissible Gastro Enteritis
Latin ***corona***, *meaning* "crown" or "wreath"

Group IV: ssRNA positive-strand viruses

Order: Nidovirales
Family: **Coronaviridae**
Subfamily: *Letovirinae*
Genus: *Alphaletovirus*
Subfamily: *Orthocoronavirinae*
Genus: *Alphacoronavirus*
Subgenus: Tegachovirus
Species: Transmissible gastroenteritis virus
Genus: *Betacoronavirus*
Subgenus: *Sarbecovirus*
Species: Severe acute respiratory syndrome-related coronavirus
Genus: *Deltacoronavirus*
Genus: *Gammacoronavirus*
Subgenus: *Igacovirus*
Species: *Avian coronavirus* - Avian Infectious Bronchitis Virus
Subfamily: *Pitovirinae*
Genus: *Alphapironavirus*
Subgenus: *Samovirus*

Properties of Coronaviruses

- Virions are **pleomorphic or spherical** (genus *Coronavirus)*
- **80-220 nm** in diameter
- **Virions** are **enveloped** with large club-shaped peplomers .
- Icosahedral internal **core structure** within which is a **helical nucleocapsid** (genus *Coronavirus)*
- The **genome consists of a single molecule of linear positive sense,** single-stranded RNA, 27-32 kb **in size; the genome is** 5'-capped, 3'-polyadenylated, and is **infectious.**
- Coronavirus virions contain three or four structural **proteins"**a major peplomer glycoprotein (S), transmembrane glycoproteins (M and E), a nucleoprotein (N), and, in some viruses, a hemagglutinin-esterase (HE).
- **Viruses replicate in the cytoplasm**;
- Virions are formed by budding into the endoplasmic **reticulum** and are released by exocytosis.



Avian Infectious Bronchitis Virus

Infectious bronchitis (IB) is a poultry viral disease caused by a coronavirus.

Host:

IB affects *Gallus* of all ages, but is more severe in young poultry.

Tropism

Primary site of infection: epithelial cells of respiratory or enteric tracts. **G**enital duct & Ovary. Neurological tissues are also frequently infected.

Transmission

The virus spreads in **aerosol** and is transmitted by the respiratory route. Droppings and nasal discharge are the virulent matter. Transmission is horizontal either directly from bird to bird or indirectly via personnel or material.

Antigenicity

The essential coronavirus characteristic is antigenic plasticity, because of the variable amino acid sequences of spicules on the surface.

Many serotypes exist and the most frequent is the Massachussetts strain, and new variants like the 'Qx' strain.

Avian Infectious Bronchitis Virus

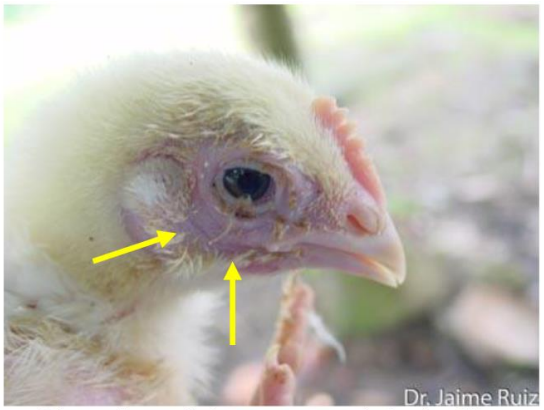
Massachusetts strain (Most frequent),
Beaudette strain,
Connecticut strain,
'Qx' strain - New variant

Clinical Picture

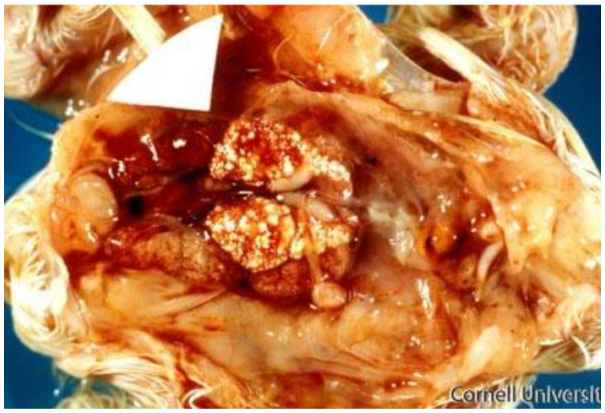
The clinical presentation of infectious bronchitis depends on the age, genetic background, and immune status of the bird at the time of infection, route of exposure, nutritional factors (especially levels of calcium in the diet), virulence of the virus strain, and the presence of stressors such as cold temperatures, poor ventilation or secondary bacterial pathogens.
Outbreaks may be explosive, with the virus spreading rapidly to involve the entire flock within a few days.

Incubation period : 18–48 hours.
In chicks 1–4 weeks of age, virulent virus strains produce severe respiratory disease, with gasping, coughing, tracheal rales, sneezing, nasal exudate, wet eyes, respiratory distress, and, occasionally, swollen sinuses.
Mortality in young chicks is usually **25–30%**, but in some outbreaks can be as high as **75%**. Less virulent strains cause fewer and milder respiratory signs, and lower morbidity and mortality rates.
Infection of young female chicks may result in **permanent hypoplasia of the oviduct** that is evident later in life as **reduced egg production and inferior quality eggs**.

IBV, Chick: Severe Gasping, respiratory distress



Chronic epiphora associated with IBV can lead to secondary periocular feather loss.

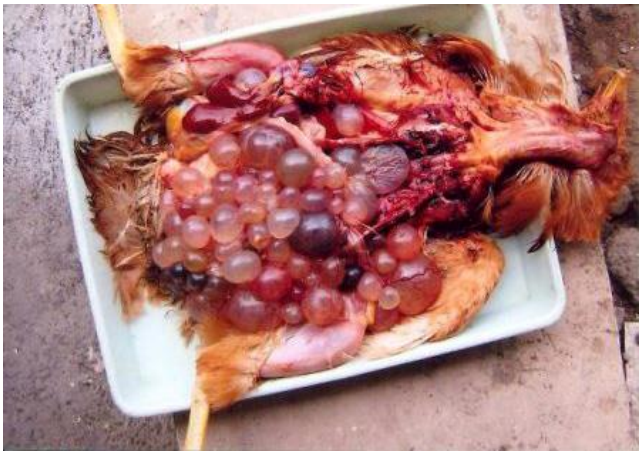


***Swollen kidneys** with white accumulation of urates. Nephropathogenic strain IBV*

Clinical signs in layers:

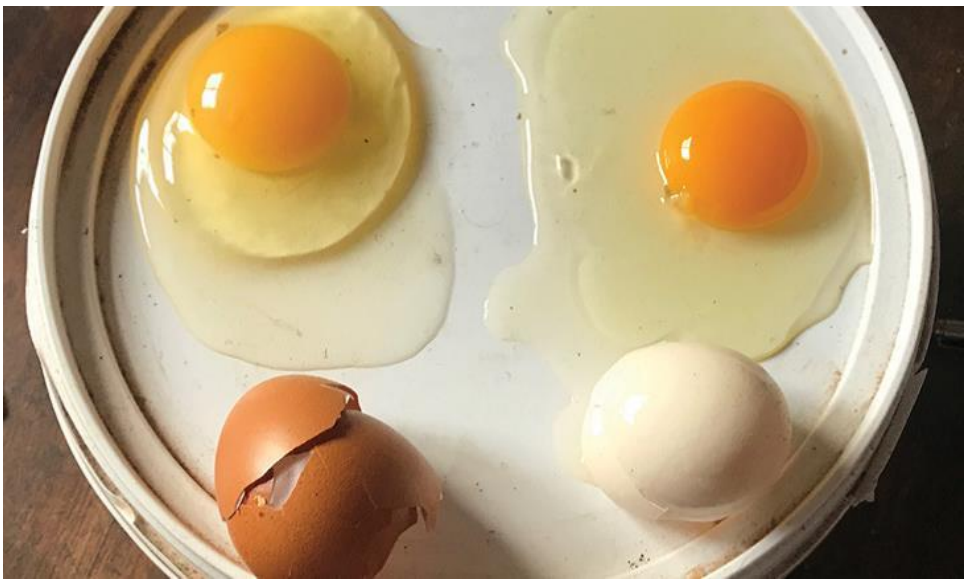
- Egg production and quality affected.
- IB infection involves **respiratory signs in broilers**, **drops in egg production** and deterioration in egg quality in layers. Some strains are also nephropathogenic.
- Internal and external egg quality alteration in laying hens experimentally infected with Massachussetts IB strain.
- In layers, the disease causes **drops in egg production**, commonly by from 5 to 15%, and by up to 50%. The drop lasted for approximately 4 weeks and production did not return to the preinfection level.
- Infected hens laid fewer eggs and the **shell quality and internal quality were inferior IB**-infected hens laid eggs with a **watery albumen consistency** and yolk size was smaller. The classic 'IB egg', an **egg that is wrinkled and corrugated**.

- Coronavirus infection in the **shell gland cells** causes declines in egg shell quality: thin, **soft, misshapen or pale unpigmented shells**. The thin and watery albumen occurs when the coronavirus affects the cells of the magnum.



The deformed and pigmentless eggs

IBV, Adult: More subtle
dyspnea, tracheal rales caused by accumulation of exudate in upper resp. tract, pneumonia in lungs.



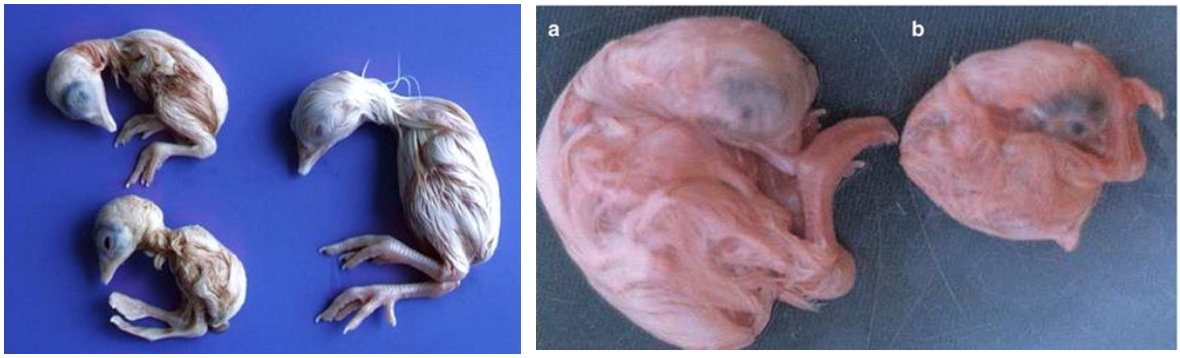
Watery albumen consistency and yolk size was smaller. The classic **'IB egg'**

The watery albumin is a result of the IB virus destroying the endometrial mucin secreting cells in the magnum of the oviduct.

Diagnosis

1.Virus isolation is usually done in 9–10 day of age embryonated specific pathogen free (SPF) eggs. Several blind passages may be necessary before clinical signs characteristic of IBV are observed in embryos. Typical lesions in embryos occurring at about 5–7 days post inoculation are **curling and dwarfing of the embryos, clubbing of down, red or haemorrhagic embryos**, and possibly **white urate deposits in kidneys**.

Tracheal organ cultures (tracheal rings) may also be used for isolation of IB viruses. In this case, **ciliostasis** and **damage to the tracheal epithelium are seen within 48 to 72 hours of inoculation**, when the tracheal rings are observed under low power microscopy. This **method gives results more quickly than does the use of embryonated eggs**, but the identity of the isolate as IB must be confirmed by other methods since IBV is not the only pathogen that may cause ciliostasis of tracheal epithelium (ciliostasis - The loss of movement of the cilia).



Comparison of a normal 18–day old chicken embryo (right) and two infected embryos of the same age, showing dwarfing

2.Immunofluoresence Test with fluorescein-conjugated antibodies that attach to the IBV when present in tracheal smears.

3.Antibody determination
Testing serum samples at intervals (for example at the time of the clinical signs and 2 or 3 weeks later) provides the basis for serological diagnosis.

4.Agar Gel Precipitation Test (AGP)
Can be useful to detect a recent IB infection. Although it has the advantage of being quick and easy to perform, it is very insensitive and would only be used as a quick way to detect a recent infection.

5. Virus Neutralisation test (VN)
The virus neutralisation (VN) test is by far the most accurate method available for differentiating between IBV serotypes as well as for confirming the identity of new ones.

6.Haemagglutination Inhibition Test (HI)
IBV does not spontaneously agglutinate chicken red blood cells, therefore it needs to be treated with the enzyme neuraminidase before it can be used in the HI test.
The test is a possible alternative to the VN test, as it is much simpler and quicker. The HI test may be serotype specific, but only if it is performed by experienced workers, under tightly controlled laboratory conditions.

7.Enzyme linked immunosorbent Assay (ELISA)
Specific antibodies in serum bind to the virus, which is attached to the bottom of a 96–well plastic plate. The complex is detected by an enzyme–labelled anti–γ-globulin.

8.Molecular detection of virus and serotypes
A multitude **of RT-PCR and qRT-PCR-based methods** have been validated, either generic and targeting virtually all IBV subtypes, or genotype- or strain-specific. The most commonly targeted region is the **S1 gene**, where the genetic variability featuring IBV variants is concentrated
SARS-CoV 2 Real Time PCR
Envelope gene (E) of Sarbecovirus, and **RNA-dependent RNA polymerase** (RdRp) and **Nucleocapsid** (N) genes of SARS-CoV-2.
Vaccination Schedule – Infectous Bronchitis (Layers)

Vaccine	Age of Layer birds	Route
Avian Infectious Bronchitis Massachusetts strain	3-4 Weeks	intraocular
	14-16 Weeks	intraocular/Drinking water/Beak dipping

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Transmissible gastroenteritis in Swine

Family: **Coronaviridae**
Subfamily: *Orthocoronavirinae*
Genus: *Alphacoronavirus*
Subgenus: Tegachovirus
Species: Transmissible gastroenteritis virus

Transmissible gastroenteritis (TGE) in swine is an acute rapidly spreading vial disease of swine of all ages characterized by diarrhoea, vomiting, high mortality in piglets under 2 weeks of age.

Four distinct coronavirus disease patterns in swine:
(1) vomiting and wasting disease,
(2) porcine epidemic diarrhea,
(3) **transmissible gastroenteritis**, and (4) respiratory disease.

Pathogenesis

The **virus enters the body by ingestion**, and after an incubation period of 18 to 72 hours **Virus reaches and infect villous enterocytes of the small intestine**.
These cells are **destroyed by the infection**, resulting in shortening and blunting of villi.
Villous enterocytes are the source of lactase and other disaccharidases needed in the digestion of milk absence of enzymes results in an increased osmolarity of the intestinal contents, resulting in water transport from tissues into the intestinal lumen.
The consequence is diarrhea.

Clinical Features

Clinical signs are **most severe in very young piglets**.
Most, neonates succumb, whereas few deaths occur in animals more than 3 weeks of age.
Piglets present with **vomiting** followed by **profuse yellowish diarrhea**, **weight loss**, and **dehydration**. Time until death is 2 to7 days after the onset of clinical signs in **piglets less than one week of age**.
In **older animals**, the **duration of diarrhea is shorter** and vomiting is seen only rarely.
Anorexia, fever and agalactia.

Laboratory Diagnosis

1. Virus isolation is carried out in porcine thyroid or testicle cells; there is cytopathology and isolates are identified by serology, usually using an enzyme immunoassay.
2. Immunofluorescence or immunoperoxidase
3. Using paired serum samples and either **serum neutralization or enzyme immunoassay.**

Prevention, and Control

Protection of swine by **attenuated virus vaccines has not been very effective**: the best protection has been obtained when virulent virus has been administered to pregnant sows, thereby boosting lactogenic immunity in piglets.
Control also involves good sanitation and management practices.
Control was maintained by extensive serological monitoring

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