

Caprine Arthritis Encephalitis

Caprine arthritis encephalitis (CAE) is a viral disease of goats. The virus that causes CAE is one of several small ruminant lentiviruses in the family *Retroviridae*. Retroviruses cause chronic viral infections in many vertebrate species, e.g., HIV in humans. Infection occurs when the viral genome is inserted into an animal's DNA, producing new viral particles with the host's cellular machinery and infecting tissue macrophages, which can establish infection in multiple organs and evade the goat's immune system. This mechanism allows the virus to persist for the life of the animal. CAE might cause one or more of the following clinical signs: arthritis, pneumonia, mastitis, as well as weight loss in goats and encephalitis in kids.



Goats test-positive for CAE might appear healthy, and some might never develop the severe clinical signs attributed to the disease.

What signs indicate a herd might have CAE?

The clinical signs of CAE vary depending on a variety of factors, including the location of infection, virus strain, age and condition of the animal and, potentially, the animal's genetic background. About 70 percent of animals with CAE, however, show no clinical signs of disease, which might be due to low or nonpathogenic strains of virus.⁶ Just one or two clinically affected animals might be the first indication that a herd is infected, although chronically infected herds might reach an infection prevalence near 100 percent.⁶ Arthritis due to CAE is common in sexually mature goats, and affected goats become lame over time with varying severity, but lameness invariably progresses. Distention at the knee, or carpal joint, is the most classic presentation of CAE in adult goats.

Infected animals also lose body condition and develop a rough coat. In addition, labored breathing due to pneumonia might be present in mature goats and in kids. Other clinical signs of CAE include indurative mastitis, a hardening of the udder caused by an infected animal's immune response to the virus. Animals with indurative mastitis usually have low or nonexistent milk production. Additionally, weight loss is one of the most common signs of CAE infection in herds.⁸



Clinical presentation of arthritis due to CAE infection, causing swollen knee joints, weight loss, and paralysis of the affected limbs. (photo credit: Panei, C.J. 2016)

What does encephalitis look like in kids?

Encephalomyelitis is an inflammation of the tissues in the brain and brain stem and is common in kids 2 to 4 months old. Initially, affected kids will be lame, their gait will be wobbly and misdirected, and correct placement of their hind limbs and hooves will become difficult. As the disease progresses, paralysis of both limbs on one side of the body, or paralysis of all four limbs, will occur. Standing will become impossible, so the goats might lie on their sides and "paddle." Other signs include depression, circling, head twitch, head tilt, exaggerated upward or sideward tilt of the head, and muscle tremors.



Head pressing is a common behavior in kids affected by encephalomyelitis caused by the CAE.

How is CAE transmitted among goats?

Consumption of infected colostrum or milk is the main transmission route of the CAE virus. Other routes include *in utero*, kidding (vaginal), saliva and respiratory secretions from the dam, and cross contamination of colostrum between does.⁹ The CAE virus has been found in cells and tissues along the entire reproductive tract of does. This finding strongly supports the possibility of prenatal transmission. The current belief, however, is that no more than 5 to 10 percent of kids are born with CAE.⁸

Both symptomatic and asymptomatic animals can transmit the CAE virus to other animals. The risk of transmission among high-density goat herds—often seen in commercial dairies—is higher than in low-density herds due to the increased stress and contact among animals in high-density herds. Transmission might occur through contact with contaminated items or biological secretions, even when there is not clear evidence of contamination or infection. Some studies have shown the incidence of CAE in dairy goat herds is greatest with high-stocking density; no control measures; deep manure as the only bedding; feces contamination of feed and water; frequent introduction of new animals; and unrestricted use of tattoo, drench, and vaccination tools.⁷ In addition, the CAE virus has been isolated from the semen of experimentally and naturally infected bucks. Therefore, caution should be taken when using natural or assisted reproduction with semen from seropositive bucks or from bucks from other producers with unknown CAE status.

Potential sources of CAE virus transmission include:⁹

- Milking machines
- Milk buckets
- Hands and hand towels
- Leaky udders
- Estrous mucus
- Prepuce mucus
- Semen
- Saliva and nasal secretions
- Colostrum and milk from infected does
- Farm and medical equipment such as needles, tattoo devices, and dehorner



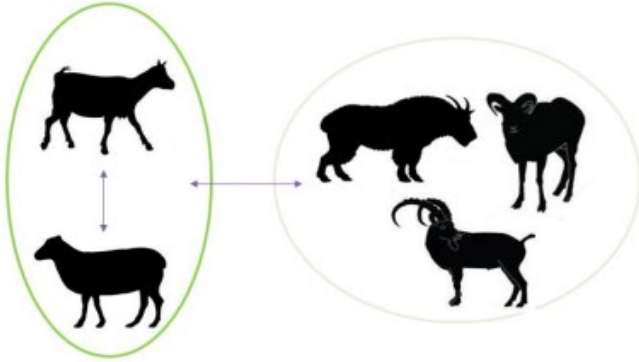
Transmission of the CAE virus through colostrum and milk is the most common route of transmission.

Live-animal trade is thought to be a major risk factor for CAE virus transmission from one herd to another.^{5, 6, 7} The live-animal trade is also a primary contributor of disease dispersion in large geographical regions. During early investigations of CAE virus prevalence in Mexico, officials found that many infected goats had been imported from the United States, while Mexico's indigenous Criollo goats were not infected.

The CAE virus can also infect other animal species, in addition to domestic goats. For example, there is strong evidence that the virus can infect sheep and that lentiviruses of sheep can naturally infect goats.⁶

The routes transmission between species include the ingestion of virus-contaminated colostrum or milk as well as respiratory secretions from direct contact between goats and sheep in densely stocked barns. Producers that raise both species should be aware of the possibility of interspecies transmission of goat and sheep lentiviruses. When a control program for one species is being designed, the mere presence of the other species and its potential to transmit the infection should be of utmost importance.^{2, 6} Evidence of lentivirus infection has been found in wild ruminants, and experimental infection with the CAE virus has shown that these wild species are susceptible to the virus. Although

lentiviruses of wild ruminants might not currently pose a threat to domesticated goats and sheep, there is the potential for cross-species transmission that could lead to new genetic variants of these viruses. Fortunately, at this time there is no evidence that CAE is a zoonotic disease, meaning it will not cause disease in humans and is not considered a risk to food safety.⁵



Cross-species transmission of small-ruminant lentiviruses has been proven in naturally infected animals. This source of disease transmission could lead to new genetic variants of the CAE virus and more serious disease in domestic goats (illustration credit: Minardi Da Cruz, J.C. Et al 2013)

What can be done to minimize the transmission of the CAE virus?

Although vaccines have been developed against the CAE virus, none has initiated an effective immune response in tested goats. Therefore, no commercial vaccines to prevent CAE are currently available.¹

The primary underlying basis of CAE control programs is preventing transmission of the CAE virus from does to kids, followed by preventing transmission of the virus among adult goats. A proven way to prevent virus transmission is preventing kids from nursing infected does and providing kids with virus-free colostrum and milk.¹ There are a number of recommended biosecurity practices designed to prevent transmission among adult goats. Producers that want to reduce the burden of disease among their animals should consider implementing the following biosecurity practices:⁵

- Strict control of new animals entering property
- Separate newborn kids from their does
- Feed uninfected colostrum, milk, or milk replacer
- Separate pastures for rearing young goats
- Remove or cull infected animals
- Disinfect animals areas regularly
- Disinfect and temporarily vacate premises in heavily infected herds
- Conduct diagnostic testing of existing and new animals

Efforts to develop accurate and reasonably priced diagnostic tests for the CEA virus have been intensive. At least three enzyme-linked immunosorbent assays are available commercially from U.S. companies. A recent study found that these three assays have a high agreement, meaning that they can consistently detect positive and negative cases.⁴ These tests, however, determine if the animal has mounted an immune response to the virus, but does not indicate the presence of virus. Therefore, these animals are defined as seropositive or seronegative, based on the laboratory results. Virus isolation is used to detect CAE virus specifically, rather than CAE virus antibodies; however, using this method in a farm setting is often unpractical. Producers should consult their local veterinarians about laboratories that provide diagnostic services for the CAE virus.

One alternative measure for controlling CAE is propagating disease-resistant goat breeds. For example, the disease rarely occurs in some indigenous goat breeds in European, Middle Eastern, and African countries, which might indicate that these breeds are resistant to CAE virus infection.⁸ These goat breeds, however, have little contact with imported commercial breeds, so they might actually be naïve hosts for the infection, rather than resistant to it. Some studies have indicated a lower seroprevalence of CAE virus among Saanen goats in Australia, Golden Guernsey and Toggenburgs in Great Britain, and Black Boudein goats in Israel.⁹ At this time, however, there is minimal evidence that certain goat breeds are more resistant to CAE virus infection than other goat breeds, although future research might identify specific breeds that are resistant to the infection or to developing clinical of the disease.

Is CAE infection widespread?

The seroprevalence of the CAE virus ranges from 30 to 80 percent among dairy goat herds in the United States and Europe. Multiple eradication efforts have been implemented in European countries. In contrast, the United States has never implemented a CAE virus eradication program.^{1, 2, 5} Eradication in Switzerland began in 1984 when seroprevalence was 60 to 80 percent. Enforced nationally, the Swiss program has been extremely successful. In 2017, a national census using new diagnostic tests revealed that the herd-level seroprevalence in Switzerland has declined to 0.38 percent.² Other eradication programs were initiated in New Zealand, France, and Italy, and all have been successful.⁵ The largest challenges to maintaining a successful CAE virus eradication program have been financial costs and producer compliance.

While the aforementioned efforts have greatly reduced the seroprevalence of disease within goat herds, such efforts are easier to implement and enforce in smaller countries than in large nations such as the United States. The best way for producers to control the prevalence of the CAE virus is to consult their

veterinarian and implement the previously mentioned strategies in this information sheet.

How does CAE affect the cost of raising goats?

The pain and disabilities associated with CAE significantly reduce the quality of life of infected goats; however, the extent to which the disease might adversely affect productivity is not clear. In countries with a high prevalence of CAE virus, animal trade might be limited, and animals might be culled to control the disease. Milk production in infected does decreases by 10 to 15 percent compared with noninfected does.^{5, 8, 9} In addition, loss of genetic merit could be considered a major economic loss in high-prevalence herds. Goat producers should be aware of the increasing consumer demand for products derived from food animals with impeccable health statuses.

NAHMS Goat 2019 study

The USDA's National Animal Health Monitoring System (NAHMS) will conduct a national study of the U.S. goat population in 2019. NAHMS collects management data through surveys to discover potential strategies for reducing the burden of disease among U.S. livestock. Producers interested in supporting their industry are encouraged to participate in the study. Information on the NAHMS Goat, 2019 study can be found at <http://www.aphis.usda.gov/nahms>.

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