

Feline Leukemia Virus: A Cause of Immunodeficiency in Cats

What is feline leukemia?

Feline leukemia is a cancerous disease caused by feline leukemia virus (FeLV). FeLV causes diseases other than leukemia including other cancers and immunodeficiency. Cats may not start to show signs of disease for months or years after being infected with FeLV. Infection with FeLV is a major cause of illness and death in domestic cats. Approximately 2.3% of cats in the United States are infected with FeLV.

What are the characteristics of feline leukemia virus?

FeLV is a type of virus called a retrovirus. That puts it in the same family as [feline immunodeficiency virus \(FIV\)](#) and human immunodeficiency virus (HIV, the virus that causes AIDS).

Retroviruses are species-specific. This means a feline retrovirus will only infect cats; a human retrovirus will only infect humans.

Retroviruses are made up of RNA. In the [host](#), the RNA is transcribed into DNA and incorporated into the DNA of the host's cells.

Retroviruses are fragile, being easily inactivated by ultraviolet light, heat, detergents, and drying.

Retroviruses are widespread in nature, and have occurred for many millions of years.

How common is FeLV infection?

It is estimated that 1-2% of otherwise healthy cats are infected with FeLV. Males are more commonly infected than females, and cats with access to the outdoors are more at risk of becoming infected than indoor cats. Kittens are much more susceptible to FeLV infection than adult cats.

How is the FeLV transmitted?

Large amounts of FeLV are excreted in the saliva. Therefore, the most common mode of transmission is through mutual grooming. Nose-to-nose contact, and shared food and water bowls can also be sources of infection. Bites are a very efficient way to transmit FeLV.

FeLV can also be found in lesser amounts in tears, urine, and feces. Thus litter boxes could be a source of infection in multi-cat households or catteries.

FeLV can also be transmitted across the placenta (*in utero*) and through the milk.

It takes large amounts of virus to infect an adult cat, so usually prolonged contact or a bite is necessary for transmission.



What happens to a cat after being exposed to FeLV?

If the cat becomes infected from exposure to FeLV, 2-4 weeks later, in the [acute](#) stage of infection, large numbers of the virus can be found in the bloodstream (viremia). Cats in the acute phase may not show signs of disease. If they do, the signs are usually fever, lethargy, diarrhea and [swollen lymph nodes](#) (lymphadenopathy). When a cat is exposed to FeLV, several things can happen:

1. Some cats will not be infected due to inadequate exposure and a good immune response.
2. Some cats will develop a [latent](#) infection; these cats will not be able to destroy all of the viral RNA and DNA, but will be able to hold it in check. This is called a latent or regressive infection. These cats show no signs of infection and usually do not shed virus in their saliva or other body secretions.
3. Some cats will become persistently infected; these cats will not develop an adequate immune response and will remain permanently infected with FeLV. This is called a progressive infection. These cats will shed large amounts of virus in their saliva and often develop FeLV-associated diseases within a few years.

Age is a very important factor in determining what will happen after a cat is exposed to FeLV. Almost all FeLV-exposed kittens less than 8 weeks of age will have persistent viremia, show signs of disease during the acute phase, and become permanently infected.

What diseases are associated with FeLV infection?

FeLV can cause:

- Weight loss
- Fever
- Immunodeficiency and infections
- Anemia
- Immune-mediated diseases
- Reproductive problems
- Gastrointestinal disease
- Neurologic disease
- Platelet disorders
- Lymphadenopathy (enlarged lymph nodes)
- Cancer
- Respiratory and eye problems
- Oral disease



Immunodeficiency: FeLV can decrease the effectiveness of the [immune system](#) and result in increased susceptibility to bacterial, fungal, [protozoan](#), and other viral infections. [Feline Infectious Peritonitis](#) (FIP), for instance, is much more common in FeLV-infected cats. The first indication of FeLV infection in some cats is recurrent bacterial infections of the mouth. Recurrent skin or respiratory infections can also occur.

Anemia: FeLV often affects cells in the bone marrow. As a result, most FeLV-infected cats have a nonregenerative anemia.

Immune-mediated Diseases: Large amounts of the FeLV [antigens](#) combine with the cat's antibodies and form complexes which can be deposited in the kidneys, blood vessels, or joints.

Reproductive Problems: FeLV infection is often associated with infertility in cats. Abortions, stillbirths, and [fetal resorption](#) are also more common in FeLV-infected queens. "Fading kitten syndrome" may result from FeLV infection of the fetuses or newborn kittens.

Gastrointestinal Disease: FeLV-caused cancers of the stomach or intestines. FeLV-associated changes in the intestinal wall can cause [anorexia](#), vomiting, diarrhea, and weight loss. Parasites and bacteria more commonly multiply and cause diarrhea in FeLV-infected cats.

Approximately 30% of FeLV-infected cats will develop cancer.

Neurologic Disease: Seizures, blindness, [paralysis](#), changes in behavior, and [ataxia](#) (loss of balance) can be seen in FeLV-infected cats. These symptoms may be caused directly by FeLV or by parasites (*Toxoplasma gondii*) and fungi (*Cryptococcosis*), which occur more often in [immunosuppressed](#) animals.

Platelet Disorders: A decrease in the number of [platelets](#), ([thrombocytopenia](#)), or a dysfunction of platelets sometimes occurs in cats infected with FeLV.

Lymphadenopathy: Lymph nodes in the abdomen and other parts of the body are often enlarged.

Cancer: Approximately 30% of FeLV-infected cats will develop cancer. Usually, the cancer is in the form of tumors of [lymphocytes](#) or red blood cells, and includes lymphosarcoma, lymphoid leukemia, myeloid leukemia, and erythremic myelosis. Not all cats infected with FeLV will develop leukemia or lymphosarcoma, and not all cases of leukemia and lymphosarcoma are caused by FeLV.

Respiratory and eye problems: Cats may show signs of [upper respiratory disease](#), especially nasal discharge (runny nose). Eye discharge may also be seen.

Oral disease: Ulcers in the mouth and infections of the mouth (stomatitis) and gums (gingivitis) are common.

What are the clinical signs of disease?

The clinical signs of disease are going to be variable because so many body systems can be affected. Loss of appetite, fever, weight loss, and weakness are the first signs most commonly seen in infected cats.

How is FeLV infection diagnosed?

Serologic (blood) tests are commonly used to test both [asymptomatic](#) and symptomatic cats for FeLV antigen (parts of the virus). The ELISA test can be performed in veterinarians' offices. If the ELISA test is positive, a confirmatory test should be done.

Approximately 2.3% of cats in the United States are infected with FeLV.

One confirmatory test is the immunofluorescent antibody (IFA) test, which uses blood smeared on a slide and is performed in special diagnostic laboratories. Fluorescently-tagged [antibody](#) made in the laboratory reacts with the FeLV antigen in the blood and fluoresces when viewed through a special microscope.

A polymerase chain reaction (PCR) test is also available which can be helpful if the ELISA test and confirmatory test do not agree.

In 2008, The American Association of Feline Practitioners (AAFP) revised their guidelines for FeLV testing. They recommend that all cats be tested for FeLV. In addition, cats should be (re)tested:

- During sickness: Regardless of previous negative results. While many signs (such as fever, stomatitis, vomiting, and diarrhea) are obvious indicators of illness, other signs are subtle and may include changes in behavior, grooming, and eating habits.
- When being adopted/entering new home: Regardless of age and whether or not they will be entering a household with other cats. They should be tested prior to being introduced into the household.
- When living in multi-cat households in which another cat is infected with FeLV, or are otherwise at high risk (e.g., cats that go outdoors unsupervised).
- After potential exposures: When cats have had known or possible exposure to other cats who are infected or are of unknown infection status. If a negative test is obtained, the test should be repeated after a minimum of 30 days.
- Prior to initial FeLV vaccination: FeLV vaccine should not be given to FeLV infected cats.

In addition, it is important to note that:

- No test is 100% accurate. In populations of cats with low FeLV infection rates, many positive tests may be [false positive](#).
- Any positive ELISA test should be repeated.
- In most cases, the ELISA test should be used as the screening test, and IFA as the confirmatory test.
- ELISA tests using tears or saliva are not recommended.
- All cats with a negative result but with the potential of having been exposed to FeLV should be retested after a minimum of 30 days.
- All cats with a suspected or known exposure should be tested.
- If the ELISA is positive but the IFA test is negative, the cat should be retested in 60 days and then annually until test results agree.
- The vaccine will not interfere with FeLV testing.
- The vaccine will not affect the course of disease in already infected cats. A "carrier," though, who is vaccinated and develops FeLV-related disease will appear to be a "[vaccine failure](#)".

Finally, a negative FeLV test does not imply the cat is immune to FeLV or was never exposed to it. A negative test could mean the cat:

- Has never been exposed to FeLV
- Is infected, but the number of virus particles is too low to detect. The cat may test positive at a later date.
- Has overcome a previous infection.

To assist your veterinarian in determining the risk of your cat being exposed to or infected with FeLV, the AAFP has developed a history form you can fill out and give to your veterinarian at your cat's next exam. Click [here](#) to see a sample form.

How is infection with FeLV managed?

FeLV-infected cats can sometimes live for years. Stress and exposure to ill animals should be avoided. FeLV-positive cats should be kept indoors both to protect them from exposure to disease and also to prevent them from spreading FeLV to other cats.

By knowing a cat is FeLV-positive, your veterinarian may select different vaccination protocols, diet, preventive care, and treatments of other diseases than for an uninfected cat. Any sign of disease will require early recognition and often more intensive treatment.



Clinically ill FeLV cats will need to be treated according to the signs of disease they are showing. Supportive care such as fluids, good nutrition, and antibiotics for [secondary infections](#) are essential.

Lymphosarcoma is treated using [chemotherapy](#) that includes a combination of cytotoxic drugs and prednisolone.

The antiviral drug AZT, which is used in human retrovirus infections (e.g., HIV), has had some success in cats, although it can cause toxic side effects. Certain agents that have used to modify the immune response in FeLV-infected cats include staphylococcal protein (SPA), *Propionibacterium acnes* (ImmunoRegulin), low doses of oral human alpha interferon, and an aloe derivative called Acemannan. Well-controlled clinic trials of these agents have not been performed.

How is feline leukemia prevented and controlled?

Vaccination: There are a number of FeLV vaccines on the market. None of them produce 100% protection. Almost all of them are derived from inactivated (killed) virus or portions of the virus. Most of these vaccines have one or two additives called [adjuvants](#) that enhance the antigenicity (ability of the virus to cause an immune response) of the killed virus. There is also a recombinant vaccine. This means a gene from the virus is placed in bacteria in the laboratory. The bacteria multiply and in doing so produce a large amount of the protein the FeLV gene coded for. This protein is collected and used in the vaccine.

In general, it is recommended that cats who go outdoors, to shows, are boarded, or otherwise have contact with cats other than those in their household should be vaccinated against FeLV. In addition, it is recommended that kittens be vaccinated against FeLV. Remember, all cats should be FeLV-tested before they are vaccinated. Adult cats who are entirely indoors may not need to be vaccinated against FeLV. This is something you should discuss with your veterinarian.

Limiting Exposure: As mentioned above, FeLV vaccines do not produce 100% protection. It is essential that the risk of exposure of a FeLV-negative cat to a potentially FeLV-positive cat be minimized. In single cat households this is best accomplished by keeping the cat indoors.

In catteries and multi-cat households:

- Test all cats for FeLV.
- Remove all FeLV-positive cats or totally separate them from the other cats.
- Disinfect all dishes, litter boxes, and bedding. Remember, FeLV can be transmitted through saliva, urine, and feces.
- Prevent or minimize the movement of cats in and out of the household or cattery.
- Test and quarantine all cats before introducing them into the household or cattery.
- Only FeLV-negative cats should be used for breeding.

What are feline vaccine-associated fibrosarcomas?

A fibrosarcoma is a tumor of the connective [tissue](#). These tumors tend to invade deeply into the underlying tissues. The frequency of these tumors is increasing in cats and has lead researchers to believe some of the tumors may be caused by a local reaction to a vaccine. Although these tumors are being seen more frequently, they are still rare. It is estimated one in every 5,000-10,000 vaccinated cats a year will develop a vaccine-associated tumor. These tumors are most commonly associated with the FeLV vaccine.

A national Vaccine-Associated Feline Sarcoma Task Force composed of veterinarians, researchers, and vaccine manufacturers are working to determine the exact cause of these tumors and how they can be prevented and

treated. Possible explanations for the tumors include abnormal reactions to the adjuvant in vaccines, genetic predisposition, and infections with another virus.

The possible risk of vaccine-associated fibrosarcomas has led to a reevaluation of vaccination protocols. This is why it is recommended that cats without potential exposure to FeLV may not need vaccination. In cats with potential exposure, the risk of FeLV infection is greater than the risk of developing a sarcoma so vaccination is advised.

A small, painless swelling sometimes develops at the site of a recent vaccination. This should disappear in several weeks. If it persists, however, it could mean it is developing into a sarcoma and should be checked by your veterinarian.

If a vaccine-associated fibrosarcoma develops, surgical removal is attempted, but generally, this tumor is so invasive it is difficult to remove it all. Radiation or chemotherapy are often recommended in combination with surgery.

Generally, the FeLV vaccine is now given in the left rear leg, in an area distinct from where other vaccinations are given. If a tumor would develop, knowing which vaccine was given where will help us determine with which vaccine the tumor is associated. Also, if a tumor would develop, amputation of the leg would, in many cases, be curative. Cats do incredibly well on three legs, and many owners prefer this to having their cat succumb to a tumor.